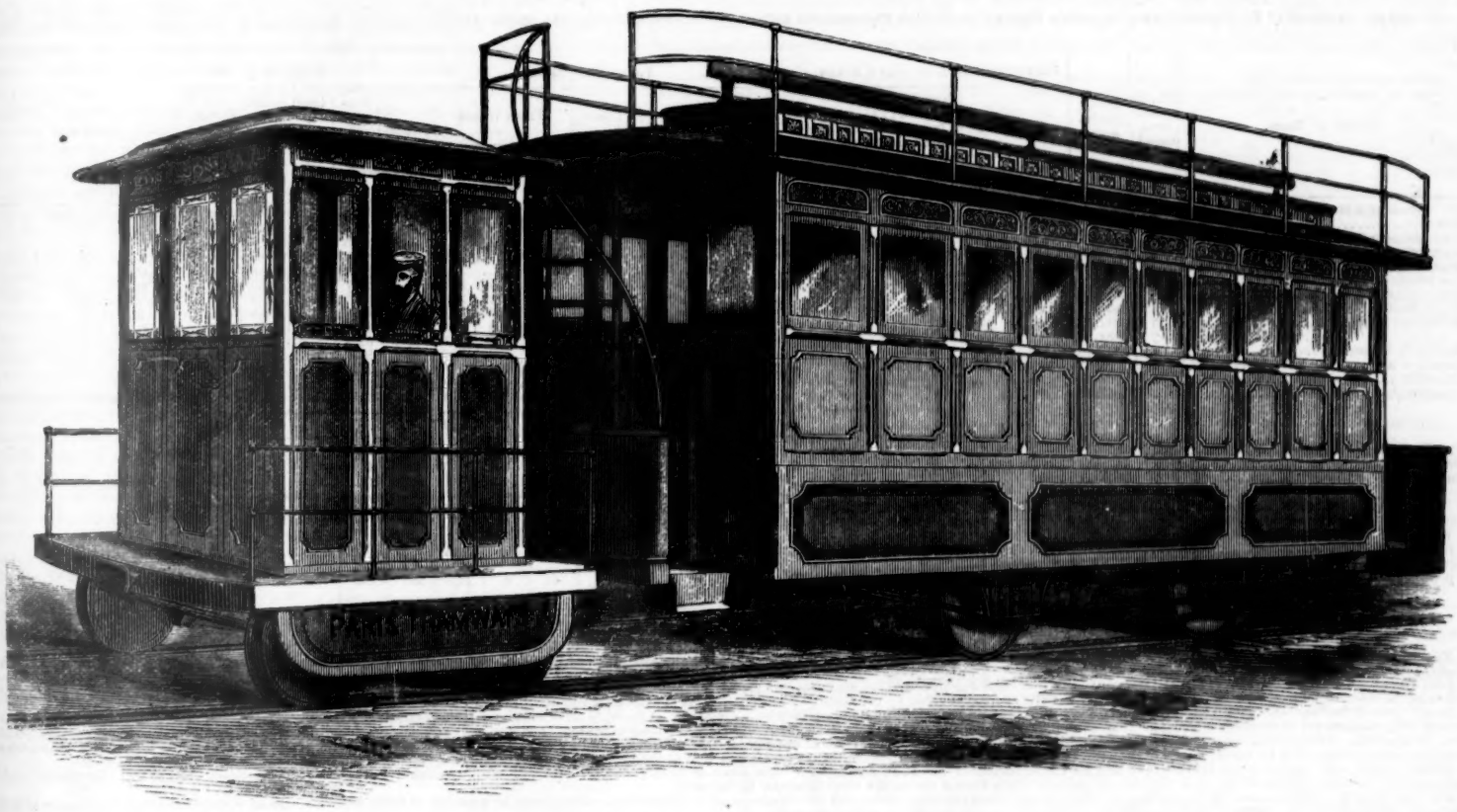
RAILROAD GAZETTE

FRIDAY, SEPTEMBER 1, 1876.

New Steam Street Car.

Our engraving shows the new steam street-car lately tested in operation in Paris, on the line from St. Germain-de-Pres to the Porte de Chatillon, a distance of 2¾ miles. The car, containing forty people, was drawn by the engine in sixteen minutes, or about 8⅛ miles per hour. On arriving at the Porte de Chatillon the engine was reversed, and made the return journey at between 9⅛ and 10 miles an hour. The engine, which is a vertical locomotive, is inclosed in a frame-work exactly like a portion of an ordinary tramway car, having a small chimney. This chimney carries off the smoke, which is really almost imperceptible. The roadway had not been cleared. In that quarter of an hour the car met riding horses, and horses in all sorts of vehicles, cabs, carriages and wagons, but caused no alarm or tremor to any. These animals certainly looked, says the observer, as if they would have liked to be relieved from drawing burdens, but that was all. There is a special advantage in the construction of this engine, which commends it to all who have any care for animal relief, in that it stops very quickly. Five feet is quite enough between brake and stand-still. And then upon the sharp curvature of the Chatillon road, caused by the rails being laid in order to avoid a gutter, where danger was even expected by many travelers, the speed was not slackened nor was there any jar. So at the corner of the Rue de Rennes, where the road is almost an angle, the same speed and the same safety ensued; and in one place, where the laziness or obstinacy of a coachman delayed the train by blocking the line, the pull-up was all but instantaneous—much quicker than it could possibly be had horses been employed.



FRENCH STEAM STREET CAR.

The part of Paris thus traversed is a populous one, and a great crowd assembled at the terminus to cheer and congratulate the promoters of the enterprise. It is believed in France that the system can be applied to ordinary roads, if they are well made and tolerably level. If so, there will follow an enormous saving to individuals in their daily expenses and in their prosecution of trade. Its cost is about a shilling an hour for coals; it is worked by a driver and stoker at say £3 3s. a week—that is to say, a total of 16s. per day against £2 10s., which is the cost of horse supply and all its attendant charges. —*The Practical Magazine.*

Contributions.

The Justifiable Expenditure for Improvement in the Alignment of Railways.

BY A. M. WELLINGTON, C. E.

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Any two proposed lines will differ from each other in one or more of the following details of alignment:

1st. DISTANCE, or length of line;

2d. CURVATURE;

3d. RISE AND FALL, or elevations overcome by the engine on gradients not exceeding the ruling grade of the line;

4th. THE RATE OF THE MAXIMUM OR RULING GRADE, a totally distinct question from that of Rise and Fall, though often confused with it; and

5th. IN THE USE OF HIGH GRADES AND ASSISTANT ENGINES INSTEAD OF A LOWER UNIFORM RULING GRADE.

The same questions arise of course in the case of projected improvements in the alignment of roads in operation.

A correct and judicious solution of the problems arising from these differences in alignment is of the utmost importance to the financial future of every railway company, especially in the all-important subject of the adjustment of gradients; and although it is true that no rules of universal and exact application can be formulated, inasmuch as no item of future business or expenses can be exactly anticipated, yet nevertheless it is believed that by proceeding on correct principles an estimate can always be made which shall be a sufficient guide for location and should always be carefully followed in preference to mere "judgment" and guesswork. The latter are most uncertain and variable guides, even in the hands of the most experienced, and lead to a vast amount of useless expenditure and expensive economy.

To compare properly these different characteristics of alignment with each other, it is essential that the value or cost of each should be referred to some common standard. The TRAIN MILE is at once the most convenient and the most exact for this purpose. It is the most convenient, because it is more easily anticipated than any other item of future business, as tonnage, for example; and it is the most exact, because it is the most uniform measure of operating expenses—the cost of a train mile being very nearly the same, whether trains are habitually run full or empty or long or short; and it is thus the most suitable measure of any increase in running expense due to alignment.

Assuming, then, the standard of the train mile (which we shall do in the form of a more convenient equivalent, viz.: the number of daily trains each way over the line), every degree of curvature and every foot of distance or rise and fall entails a certain expense (variable or constant) upon every train which passes over the line, and it is proposed in this paper:

First, to demonstrate that these sums—and the relative percentages of the different items of expense which compose them—are more nearly constant than is generally supposed, under variable conditions of traffic and location; and

Secondly, to express the amount of such expense in sums which, multiplied by the estimated cost of a train mile and the estimated number of daily trains, shall give a few sums, easily carried in the memory, which shall not only be equally convenient for the ordinary purpose of "equating," but shall also serve as an instantaneous guide as to *how much* any proposed change, great or small, is worth to the line in dollars and cents.

In order to have a sound foundation for a settlement of these problems, we must first investigate at some length the relations which the various items of the operating expenses bear to each other. This must necessarily be a dry and tedious mass of figures, but, it is hoped, will have interest sufficient to repay examination, independent of our present purpose.

THE COST BY ITEMS OF A TRAIN MILE.

If we examine the reports of almost any two widely separated railways for any one year, it will be a chance if many of the items of cost per train mile do not vary from each other 200 or even 300 per cent.; and if we take the average of several contiguous roads in each case, or of several successive years, the result will be the same in a less degree. If, however, we make a careful separation by items in each year on each road, the resemblance will be much closer, inasmuch as the accounts of almost any two roads, which are apparently much the same, will differ so much in the combination of some of the minor items as to vitiate all comparisons.

But if, for the purpose of comparison, we determine only the aggregate cost of a train mile in dollars and cents, and then determine the *percentage* which each separate item of cost bears to that sum, the resemblance will be, in the main, singularly close, if the average of each road be taken for a series of years. And if, finally, we omit all taxes, station, terminal and general expenses, which are especially dependent on locality and character of business, and include only those items of expense which vary more or less with the alignment and train mileage, and which we may group together under the general term of "Line" or "Transportation" expenses proper, the similarity in the percentage of the various items will be so close as to indicate the existence of a relationship between those expenses more nearly independent than is commonly supposed of the volume of business and even of locality; at least amply sufficient to serve as a general basis for location estimates.

The results of such a comparison are summarized in the tables given below. The writer is not aware of such having been previously compiled, owing probably to the great labor involved. Nor, it may be added, would it have been attempted by the writer except that nearly every computation for this paper was read off at once from a "Diagram of Percentages" and hardly any numerical work performed except addition and subtraction.*

The operating expenses of a railway divide naturally, at least for our purpose, under the three great heads below:

1st. MAINTENANCE OF WAY AND WORKS, including all permanent structures except repair shops and engine and car sheds.

2d. TRAIN EXPENSES, including all expenses connected with the running, handling and maintenance of the rolling stock, but *not* including any station expenses.

3d. STATION, TERMINAL AND GENERAL EXPENSES AND TAXES, most of which vary more or less with the tonnage or volume of business, but all of which are independent of, or inappreciably affected by, any of the details of alignment; and therefore for our present purpose may be included together. TAXES at first sight appear to be affected by the alignment, inasmuch as they might increase with the length of the road; but taxes are based on *value* and not on cost; and as the shortest line between two points is necessarily the most valuable, taxes, if affected at all, should be inversely as the length, so far as the length is changed for engineering reasons. Station expenses also are the same for the same business, whatever changes in the alignment may be made, unless such change brings additional business; in which case the net profit on that business is an element additional to the purely engineering question.†

Below is given a table (Table I.) showing the percentage which each of the various items of expense—divided up under the three great heads enumerated above—forms of the total aggregate expenditure on 13 representative roads of the United States. Also, at the foot of the table, similar percentages are given for the only three States which publish State summaries in any detail or of much value. All the State reports, however, as is well known, are very inaccurate in detail,

* Even with this assistance, the preparation of the necessary tables, only a small portion of which are here reprinted, has been one of much labor, and the writer was led to add one road after another to the tables below only on account of the singular uniformity, as it appeared to him, of the percentages obtained. The diagram above mentioned reads to three digits, independently of the decimal point, except that the last digit may possibly be a unit in error; *e. g.*, the proper figures may be .0176 instead of .0177, or 14.5 instead of 14.4. The vanity of decimal precision is thus necessarily sacrificed, but the writer considers it more an obstruction than an assistance, both to the reader and to the value of the results. Of what possible value is a knowledge of the fact that fuel and water cost 11.6261 cents per train mile, as per reports of the Louisville & Nashville Railroad, instead of the even figures 11.6 cents?

† A neglect of the consideration that all items which vary with *tonnage* are not affected by the *alignment*, leads to a great over-estimate of the value of distance. Thus, Mr. Herman Haupt, in a paper on the value of distance on the Pennsylvania Railroad (*Van Nostrand's Engineering Magazine* Vol. IV., p. 593) includes such items as "station labor, $152,883," "teaming, $109,125," etc. It would be hard to say how the length of the track affects the cost of carting freight at the termini.

and have only the advantage of a wide general average; the Massachusetts reports being the best and those of Ohio especially inaccurate and unsystematic, as respects uniformity in the individual reports.

The 13 roads given are as widely separated in location and exhibit as great a variety both in the character and in the volume of business as it was possible to compile from the reports accessible to the writer, and the shortest period averaged in any case is four years, except in the case of the Philadelphia & Reading Railroad, for which a subsequent table is given (Table VI.) covering a period of 24 years, which shows that the relative percentages have varied but little, but which it was impossible to include in Table I. for the entire period from lack of the requisite data, owing to the peculiar system of accounts in use on that road, as explained in the Notes to Tables I. and VI. The separate tables for each road, from which Table I. was condensed, are omitted as too voluminous, but in many cases they show wide fluctuations from year to year.

Table II. gives similar percentages to Table I., so far as the character of the State Reports enabled them to be compiled, for several States in addition to those given in Table I. So far as they go, they serve to confirm the general accuracy of the results indicated by Table I., as is evident from the abstracts from Table I., reprinted at the foot of the table.

Table III. is computed directly from Table I. by omitting all station, terminal and general expenses, in the case of each road, and including only what we may call the "Line" or "Transportation" expenses, that is to say, those which are directly connected with the running of trains, which includes the two heads of "Train Expenses" and "Maintenance of Way." This includes all items which are perceptibly affected by the characteristics of alignment.

If these tables be carefully examined—and more especially Table III.—they appear to the writer to disclose a remarkable uniformity in the ratio of the various items of transportation expenses to each other, especially in the ratio of the total cost of running trains to the cost of maintenance of way, under wide fluctuations in the character and volume of business. Thus, in Table III., the cost of maintenance of way only varies from 33.5 per cent. of the total "Line" expenses, in the case of the Philadelphia & Reading Railroad to 42.6 per cent. in the case of the Pittsburgh & Connellsville when engaged in heavy road repairs. The next highest was the Lake Shore & Michigan Southern, 41 per cent., which was charging steel rails to maintenance without deduction for old iron, and the next highest was the Boston & Maine, 40.6 per cent., which is almost exclusively a passenger road; but with these exceptions, not a single one of the remaining ten roads varies more than a fraction over 3 per cent. from the general average of 37 per cent., nor is there any evidence apparent that the relative cost of maintenance of way decreases with increase of business. We shall see reason to believe, under the head of "Maintenance of Way," that this somewhat singular result is more than a coincidence.

The same uniformity follows in the various items of "Train Expenses." Thus, in Table III., the cost of running engines varies only 2 or 3 per cent. from the average of about 30 per cent., except in two or three instances, notably the Cheshire Railroad, the shortness of which, 54 miles, evidently operates to increase the cost of motive power.

These tables seem to indicate a very general uniformity of relationship in the expenses of American railways (the cost of fuel being the greatest disturbing element)—a uniformity so great that any seeming exceptions may fairly be considered as due to local or temporary causes. In order to determine, however, if the same law of uniformity will hold universally true, we will make some comparisons with a few English railways. The official returns of the Board of Trade afford a very meagre basis for this purpose, but accurate so far as it goes, and with the advantage that all returns are made upon precisely the same system.

Table IV. gives the average percentages of the various items, as returned to the Board of Trade, for three representative English railways, and also the aggregate of the English and of the Irish railways, for a period of five years in each case; and it will be observed that—excepting the Irish railways, on which we shall remark hereafter—there is a much more striking similarity in the various percentages than in the case of American railways. But it will also be observed that these percentages differ widely from those shown in Tables I. and II. for American roads.

This difference, however, is only apparent, and is owing to a singular anomaly in the English system of keeping railway accounts—in use also on the Philadelphia & Reading and a few other American roads—termed the "Renewal Fund," which is formed by deducting a certain amount per ton or per passenger transported directly from the receipts for the renewal of iron and rolling stock, which is not charged in with other receipts and expenses. No trace of this fund appears in the English official returns, either in the reported receipts or "Total Working Expenses," nor does any means exist, so far as

TABLE I.

Showing the Percentage of the Various Items of Operating Expenses on Thirteen Representative Railways for a Series of Years; also, Similar Percentages from the State Reports of New York, Massachusetts and Ohio.

Name of Road.	No. of years averaged.	Dates (inclusive).	Statistics for Last Year given.				Train Expenses.								Maintenance of way and works	Total of train exp's and main. of way.	Sta'n, termin'l, general exp's and taxes.	Gr'nd Total.	Remarks.
			Length.		Average No. of daily trains over main line.		Cost per rev'n'e train mile.	Engines.				Cars.	Train Wages.			Total Train Exp'ns's				
			Main Line.	Br'hs	Pass.	Fr't.		Fuel.	Oil, Water etc.	Repairs, etc.	Total.	Repairs, etc.	Eng. and F'm'n	Cond. and B'm'n	Total.					
N. Y. Central & Hudson River	5	1869–73	440	598	10.6	24.	$1.27	13.2	2.6	7.6	23.4	13.6	6.	4.1	10 1	47.1	25.0	72.1	27.9	100.	Taxes 3.7 ± per cent.
Erie	5	"	422	534	8.3	25.2	1.07	8.6	2.1	8.5	19.2	11.2	8.8	8.6	17.4	47.8	24.5	72.3	27.7	100.	" 3.7 ± "
Lake Shore & Michigan Southern	5	"	540	595	7.4	19.5	1.25	10.9	1.6	7.9	20.4	10.7	6.3	5.4	11.7	42.8	29.9	72.7	27.3	100.	" "
Pennsylvania	4	1859–74	358	426	16.	32.8	1.01	6.0	1.7	14.0	21.7	11.8	4.5	6.7	11.2	44.7	25.0	69.7	30.3	100	Taxes, tolls, etc., 7 to 9 per ct.
Philadelphia & Reading	3	1867–73	95	332	6.0	44.0	1.13	9.6	2.2	8.	19.8	13.4	.....	.....	15.0	48.2	23.2	71.4	28.6	100.	" 0
Louisville & Nashville	7	"	185	207	3.1	6.5	1 54	8.9	2.2	7.8	18.9	10.5	5.2	6.7	11.9	41.3	26.7	68.0	32.0	100.	" 0
Illinois Central	8	1865–72	456	260	3.	7.	1.10	.....	.....	.....	17.	9.	.....	.....	11.	37.0	25.0	62.0	38.0	100.	Taxes, 9 per cent.
Union Pacific	6	1870–75	1,032	.....	1.6	5.2	1.107	13.9	5.7	8 0	27.6	8 6	7.0	6.0	13.0	49.2	32.0	81.2	18.8	100.	" 0
Baltimore & Ohio	5	1871–75	380	183	7.3	25.2	0.69	6.2	3 6	11.7	21.5	13.1	8.6	8.4	17.0	51.6	32.3	83.9	16.1	100.	" "
" "	2	1864–65	"	100	4.0	10.0	0.63	6.6	4.3	15.9	26.8	9.4	8.7	7.1	15.8	52.0	31.0	83.0	17.0	100.	" "
Boston & Albany	4	1872–75	202	48	9.8	24.2	1.198	15.4	1.5	8.4	25.3	11.7	.....	.....	10.8	47.8	24.4	72.2	27.8	100.	" "
Boston & Maine	4	"	115½	11	13.3	6.5	1.045	14.7	1.5	5.5	21.7	7.	.....	.....	12.	40.7	27.8	68.5	32.5	100.	" "
Cheshire	4	"	54	.....	4.1	13.6	1.003	20.1	1.7	9.0	30.8	11.9	.....	.....	8.	50.7	23.9	74.6	25.4	100.	" "
Pittsburgh & Connellsville	4	1866–69	72	.....	1.5	3.0	0.94	3.6	2.4	15.7	21.7	7.7	8.4	6.9	15.3	44.7	33.1	77.8	22.2	100.	" " (under construction)
Average	.....	.....	.....	.....	.....	.....	$1.05	10.4	2.5	9.7	22.6	10.6	6.6	6.3	12.9	46.0	27.4	73.4	26.6	100.	
New York State railroads	5	1869–73	6,574	1,977	3.5	8.4	1 05	11.3	1.5	8.3	21.1	10.2	6.5	6.3	12.8	44.1	26.8	70.9	29.1	100.	Taxes 3.7 ± per cent.
Massachusetts " "	5	1871–75	2,459	.....	7.4	6.7	1.19	13.5	1.4	6.8	21.7	10.5	5.5	5.6	11.3	43.5	25.2	68.7	31.3	100.	
Ohio " "	4	1870–73	3.851	524	.....	.....	0.91	8.0	1.2	7.5	16.7	9.2	6.5	6.3	12.8	38.7	28.1	66.8	33.2	100.	Statistics very unreliable.
Average	.....	.....	.....	.....	.....	.....	$1.05	10.9	1.4	7.5	19.8	10.0	6.2	6.1	12.3	42.1	26.7	68.8	31.2	100.	
Average of Pennsylvania, Michigan, Wisconsin and Connecticut — taken from Table II.	.....	.....	.....	.....	.....	.....	.....	(10.5)	(2.0)	9.1	21.6	7.	.....	.....	(12.4)	41.0	27.9	68.9	31.1	100.	
Average adopted as a basis for the purposes of this paper	.....	.....	.....	.....	.....	.....	$1.00	10.	2.	9.	21.	10.	6.	6.	12.	43.	27.	70.	30.	100.	

REMARKS ON TABLE I.

New York Central, Erie and New York State Reports.—In each case the taxes were taken out of maintenance of way and included in station and general expenses. So also in the case of the Lake Shore and other roads, where such taxes existed.

Lake Shore.—An item for car hire of about 4 per cent. was transferred from operating expenses to "repairs of engines and cars." The high per cent. of maintenance of way is sufficiently explained by the following foctnote to their report, which runs through the entire period covered by the table: "The entire cost of steel rails substituted for iron is charged to operating expenses."

Philadelphia & Reading.—This road employs the English fiction of a "renewal fund," maintained by a direct tax on receipts of 5 cents per 100 ton miles, expenditures from which are not included in what is ordinarily understood as working expenses. If an engine be *repaired*, the cost appears in the annual return of "total expenses," but if it be *rebuilt*, the cost does not appear in any total which can be compared with other roads. The expenditures from the renewal fund amount to from 8 to 15 per cent. of the annual "total" and are mainly on maintenance of way, the cost of which is thus much greater than the very small per cent. (about 17 or 18) which casual examination indicates and is commonly accepted. The same is true of English railways and some few other American roads which employ the same system.

Illinois Central.—The figures given for this road are on the authority of Mr. L. P. Morehouse ("The Cost of Transportation on Railroads," reprinted in the *Railroad Gazette* for 1874, p. 200). Doubtless some difference in the classification of expenses explains the fact that this road is one of the most irregular in the table.

Ohio State Reports.—Little value can be attached to results from these reports, except that the relative cost of maintenance of way may be accepted as fairly accurate. As an example of inaccuracy, some of the roads reporting include the wages of engine hands in the cost of "motive power" and some do not.

Pittsburgh & Connellsville.—This road was engaged in heavy road-bed repairs, filling trestles, etc., during the period covered by the table.

Average Number of Daily Trains.—Little accuracy is claimed for this column, as it was necessary to "equate" the length of the branches as nearly as the writer could judge or ascertain to be in proportion to the relative business. In most cases one third of their length was added to that of the main line. It was intended only to serve as a comparative indication of volume and character of business. The number of working days in the year was taken at 325, making some allowance for Sundays. The same number of days to a year has been assumed throughout this paper.

TABLE II.

Showing the percentage of the various Items of Operating Expenses for a series of years, as determined from the State Reports of several States which do not give items in detail. Also, abstracts from Table I., for purposes of comparison.

State.	Number of years averaged.	Dates (inclusive).	Length in last year.		Average No. of trains daily.		Cost per train mile of revenue trains.	Maintenance of way and works.	Maintenance of engines and cars.	Operating expenses.	Total.
			Main line.	Branch.	Passenger	Freight.					
Pennsylvania	4 years.	1870–73	6,830	.....	4.9	17.4	$0.83	28.0	20.0	52.0	100.
Michigan	2 "	1872–73	3,442	816	3.1	6.8	1.10	24.8	16.4	58.8	100.
Wisconsin	1 "	1873	.....	.....	.....	.....	.....	29.8	13.8	56.4	100.
Connecticut	1 "	1873	1,264	.....	4.5	2.6	1.42	29.1	14.9	56.9	100.
Average	.....	.....	.....	.....	.....	.....	.....	27.9	16.1	56.9	100.
New York (recombining items from Table I.)	.....	.....	.....	.....	.....	.....	.....	26.8	18.5	54.7	100.
Massachusetts " " " "	.....	.....	.....	.....	.....	.....	.....	25.2	17.3	57.5	100.
Ohio " " " "	.....	.....	.....	.....	.....	.....	.....	28.0	16.7	59.3	100.
Average " " " "	.....	.....	.....	.....	.....	.....	.....	26.7	17.5	55.8	100.
Average of individual roads (recombining items from Table I.)	.....	.....	.....	.....	.....	.....	.....	26.6	20.3	53.4	100.
Average adopted as a basis, for purposes of this paper (recombining items from Table I.)	.....	.....	.....	.....	.....	.....	.....	27.	19.	54.	100.

REMARK ON TABLE II.—*The average number of trains daily* is computed above, including the entire length of branches, without "equating" the length of branches as in Table I. The extraordinary excess of the freight business of Pennsylvania, over New York and other States, is as the returned mileage indicates.

Maintenance of Engines and Cars.—In Michigan this item included fuel in most reports and excluded car repairs in some others. The percentage above is accordingly about 4 per cent less than is indicated by the face of the returns. In Connecticut, the cost of fuel (13 per cent.) was deducted from the percentage given by the face of the returns.

Little value attaches to any of the results shown in this table, except as a check, as the averages are for so short a period, and all the reports are more or less inaccurate and unsystematic.

the writer can ascertain, of determining exactly what is ordinarily understood in the United States as the "Total Working Expenses" of any year, except in the private books of the several companies. Inasmuch as the main expenditures from that fund are on maintenance of way, and few Americans are aware of this system, the English railways and the English system of building railways enjoy a cheap reputation in this country for economy in that item and low cost per train mile. As a matter of fact, the English railways have no considerable advantage in these respects, if we may trust the indications of the following confessedly inexact process.

It will be observed that the percentages of the Philadelphia & Reading Railroad, as given in Table IV., with renewal expenditures omitted, agree quite closely with the percentages of the English Railways; as do also the percentages of the same road with American railways, in Tables I. and III., when the renewal expenditures are included. A more exact method of comparison, however, so far as it affects maintenance of way, is afforded by an elaborate paper by Mr. R. Price Williams, "On the Maintenance and Renewal of Permanent Way," (Trans. Inst. Civ. Engrs., 1866). Mr. Williams having had access to the accounts of eight leading English Railways (viz., the London & Northwestern, the Northeastern, the Midland, the London & Southwestern, the Great Northern, the Lancashire & Yorkshire, the Southeastern, the London, Brighton & South Coast, and the Manchester, Sheffield & Lancashire), gives a table for these roads extending over a period of five years (1860–65), showing the expenditures per mile, both from operating expenses and from the "Renewal Fund" on what is ordinarily understood in the United States as "Maintenance of Way."

From this we may determine that expenditures from the renewal fund vary from 74 per cent. on the Lancashire & Yorkshire Railway to 27.3 per cent. on the Manchester, Sheffield & Lancashire of the official return to the Board of Trade as the cost of "Maintenance of Way and Works;" the average of the eight roads being 46.5 per cent., as against 34.9 per cent on the Philadelphia & Reading Railroad. Assuming these roads to be fairly representative of the entire English railway system—and Mr. Williams states them to be so—the total cost of maintenance of way on the railways given in Table IV. would be increased to from 25 to 28 per cent. of the total expenses, including expenditures from the renewal fund in both cases. The exact amount cannot be determined for lack of information as to the expenditures from the renewal fund on the maintenance of rolling stock. These expenditures, in the case of the few American roads maintaining a renewal fund, are comparatively small, but the percentages would indicate that they are somewhat larger in England. The renewal fund apparently amounts to from 10 to 15 per cent., thus bringing the *true* cost of a train mile up to 80 to 90 cents, gold.

We thus find reason to believe that the various percentages of cost on English railways, and even the aggregate cost of a train mile, are closely approximate to those ruling in the United States, despite the great dissimilarity on the face of the returns. The Irish railways, however, form an apparent anomaly in Table IV.; the cost of maintenance of way amounting to 26.6 per cent. of the total returned expenses, instead of only 18.3 per cent. in the case of the English railways; and it will perhaps be at once concluded that this is due to the striking difference in the volume of business, which is also shown in Table IV. In the absence of information as to the comparative amount of the renewal fund on Irish railways, the writer is unable to dispute this conclusion, but can only express his belief, based upon the general identity of the results already obtained, that the Irish railway accounts are kept on a different system, and that the renewal fund is either non-existent or very small. This conclusion, which is purely *a priori*, may be easily contradicted, if incorrect, by those familiar with the facts. If it be not so, it is quite possible that, from conservatism and fancied necessity, the whole system of Irish railways is maintained in English style for an Irish business.

DIVISION OF THE EXPENSES FOR MAINTENANCE OF WAY.

An analysis of the relative cost of the different items of expense for maintenance of way is evidently necessary for our present purpose, in order to determine how great a proportion of the aggregate expense is affected by the various changes in alignment. Few roads, however, and no State reports, attempt to divide up this expense minutely under heads similar to those shown in Table V. below; but the Pennsylvania, the Philadelphia & Reading, the Louisville & Nashville and others do so in much greater detail, and Mr. L. P. Morehouse has done so for the Illinois Central Railroad in the paper before referred to. (See foot-note to Table I.) The New York and Massachusetts State reports, also, go into sufficient detail to serve as a check.

Table V. gives a subdivision of the cost of maintenance of way for each of the roads above mentioned, and the various percentages of the different items on each road have a sufficiently close general resemblance to be amply sufficient for our present purpose, if, as we shall endeavor to show below, the relative cost of maintenance of way may be accepted as very nearly the same in the aggregate—and, to a less degree, in detail—on all roads, whatever the volume of business or peculiarities of location.

The items of Table V. were necessarily grouped in the order shown in the table for purposes of comparison in preparing the table, but may be more properly and systematically arranged, after being determined, under the following heads:

		Per cent. of total expenses.
1st. *Maintenance of Track*		13 per cent.
Divided into	Renewal of Rails	7 per cent.
	Adjusting and Maintaining Tracks	6 " "
2d. *Maintenance of Road-bed*		7 " "
Divided into	Renewal of Ties	3 per cent.
	Earthwork, Masonry, etc.	4 " "
3d. *Maintenance of Yards and Structures*		7 " "
Divided into	Switches, frogs and sidings	3 per cent.
	Bridges, Bridge Masonry, etc	2.5 " "
	Buildings, except shops	1.5 " "

Of these items, only the first and second are affected by minor differences of length, and only the first by curvature or rise and fall. The third class of items is not affected by most variations in alignment, and partly for that reason and partly because more liable to fluctuation, has been separated with less care than the other items.

RATIO OF THE COST OF MAINTENANCE OF WAY TO TRAIN EXPENSES.

Unless the various items of railway expenses bear a nearly constant ratio to each other as the volume of business increases, the general formulæ hereafter to be given for the value of improvements in alignment cannot be applied, with much accuracy, alike to roads which have (or expect to have) a large business, and those having only a small one.

In the case of "Station and General Expenses" this objection is of less moment, inasmuch as the expenses which enter into that item are not affected by minor changes of alignment; and, moreover, Table I. shows the general rule to be that such expenses are very uniformly about 30 per cent. of the aggregate, taking the average of years, except in the case of such exceptional roads as the Baltimore & Ohio, the Union Pacific, and for example, the Syracuse, Bingbamton & New York, on which the general and station expenses amount to but 20.4 per cent., including taxes. Even variations so great as these, however, would cause little error in the application of the formulæ to be given.

But as respects the items which enter into the "Line" or "Transportation" expenses proper, this objection would have more weight; and more especially, if the relative cost of maintenance of way is continually changing with the volume of business, as is very frequently imagined and assumed. The following facts seem to indicate, however, that, be the cause what it may, no such changes are to be observed, either in the history of individual roads or in comparison of different roads with each other; unless in some exceptional instances or in comparisons of main and branch lines, where, it may be, the contagion of example leads to keeping up branch lines in better relative condition than the circumstances require or justify, and on which at the same time the running and general expenses are very generally less than if independently operated.

An examination of Table I. (and more especially of Table III., which is an abstract from Table I. to show the exact relationship of "Maintenance of Way" and "Train Expenses") fails to show any considerable difference in the ratio of expenses due to volume of business. Among the lowest percentages for the cost of maintenance of way is the Cheshire Railroad, and among the highest the Lake Shore, the Pennsylvania and the Baltimore & Ohio. The State averages also are practically identical with those for the great roads given above them. Several roads of comparatively small business run, indeed, somewhat above the average, but this is largely due in each case to obviously temporary causes; thus, the Union Pacific Railroad was engaged in erecting snow sheds and filling trestles during the period covered by the table. On the Baltimore & Ohio, the cost of maintenance of way *increased* about 1 per cent. during the 20 years from 1855 to 1875; the returned cost for "Repairs of Way" having been, for the five years 1871–75, 17.4 cents per train mile, and for the five years 1851–55, 13.2 cents per train mile. Similarly, the English railway returns, in Table IV., show a striking identity in the percentage of maintenance of way with varying volume of business; these returns, it must be remembered, do *not* include the cost of renewing track, which is admitted to vary very nearly with running expenses, but only of repairs and maintenance of works.

As a further fact, the following table (Table VI.) summarizes the operation of the Philadelphia & Reading Railroad for

TABLE III.

Showing the Relative Percentage of the Various Items of "Line" or "Transportation" Expenses only (i. e., the Aggregate Cost of Train Expenses and Maintenance of Way, excluding all Station, Terminal and General Expenses) for the different Railroads and States given in Tables I and II.

NAME OF ROAD.	Average No. of trains daily over main line. Pass'r	Fre't.	Total cost per train mile.	Cost per tr'n mile for "Line Expenses" only.	Train expenses. Engines	Cars.	Train wages	Total train exp's.	Maintenance of way and works.	Total of train and way expenses.	REMARKS.
N. Y. Central & Hudson River	10.6	24.0	$1.27	$0.91	32.3	18.9	14.0	65.2	34.8	100.	
Erie	8.3	25.2	1.07	0.77	26.6	15.4	24.0	66.	34.0	100.	
Lake Shore & Michigan Southern	7.4	19.5	1.25	0.91	28.	14.8	16.2	59.	41.0	100.	Steel rails charged to maintenance, without deduction for old rails.
Pennsylvania	11.	32.8	1.01	0.71	29.4	17.3	16.5	63.2	36.8	100.	
Philadelphia & Reading	6.0	44.0	1.04	0.81	27.9	18.6	21.0	67.5	32.5	100.	
Louisville & Nashville	3.1	6.5	1.52	1.04	27.7	15.4	17.5	60.6	39.4	100.	
Illinois Central	3.	7.	1.10	0.68	27.4	14.5	17.8	59.7	40.3	100.	L. P. Morehouse, authority
Union Pacific	1.6	5.2	1.107	0 82	34.0	10.6	16.0	60.6	39.4	100.	
Baltimore & Ohio	7.3	25.2	0.69	0.56	25.7	15.6	20.2	61.5	38.5	100.	
" " "	4.0	10.0	0.63	0.51	32.3	11.3	19.0	62.6	37.4	100.	
Boston & Albany	9.8	24.2	1.108	0.80	35.3	16.2	18.	66.3	33.7	100.	
Boston & Maine	13.3	6.5	1.045	0.71	31.7	10.2	17.5	59.4	40.6	100.	Passenger road, mainly.
Cheshire	4.1	13.6	1.003	0.75	41.1	15.9	10.8	67.8	32.2	100.	
Pittsburgh & Connellsville	1.5	3.0	0.94	0.73	27.9	10.	19.5	57.4	42.6	100.	New road. Filling trestles.
Average	.....	.....	$1.05	$0.76	30.7	14.4	17.6	62.7	37.3	100.	
From State Reports.											
New York State Railroads	3.5	8.4	1.05	0.75	29.8	14.4	18.	62.2	37.8	100.	
Massachusetts State Railroads	7.4	6.7	1.19	0.81	31.6	15.2	16.5	63.3	36.7	100.	
Ohio State Railroads	.....	.....	0.91	0.61	25.	13.9	19.1	58.0	42.0	100.	Statistics very unreliable.
Average	.....	.....	$1.05	$0.72	28.8	14.5	17.9	61.2	38.8	100.	
Average of Pennsylvania, Michigan, Wisconsin and Connecti't } Taken from Table II.	.....	.....	.....	.....	31.3	10.1	18.1	59.5	40.5	100.	
Average adopted as a basis, for purposes of this paper, as given in Table I.	.....	.....	1.00	0.70	30.	14.3	17.1	61.4	38.6	100.	

TABLE IV.

Showing the Percentage of Various Items of Operating Expenditures on representative English Railways for a series of years; According to the Official Returns of "Total Working Expenses" not including the cost of Renewals and Rebuilding Also, the same percentages for the Philadelphia & Reading Railroad, omitting the cost of renewals.

NAME OF ROAD.	Number of years averaged.	Dates (inclusive).	Statistics for last year given. Length. Main line.	Branches.	Ave'ge No. of daily trains. Passenger	Freight.	Cost per train mile.	Percentage of expenses. Maintenance of way and works.	Locomotive power.	Repairs cars.	All other exp'ses	REMARKS.
London & Northwestern	5 years.	1869–73	1,246	348	17.	20.4	$0.73	18.5	26.2	7.5	47.8	Taxes, rates and duties, about 6 per cent.
Great Western	5 "	"	867	635	9.1	10.9	0.70	18.5	25 9	9.2	46.4	Taxes, rates and duties, about 6 per cent.
Great Northern	5 "	"	423	121	12.4	14.6	0 71	18.7	27.7	8.5	45.1	Taxes, rates and duties, about 5.9 per cent.
Total of England and Wales	5 "	"	7,138	4,231	10.	10.7	0.77	18.3	26.7	8.2	46.8	Taxes, rates and duties, about 6 per cent.
Total of Irish Railways	5 "	"	1,000	501	4.	2.	0.78	26.6	27.4	6.7	39.3	Taxes,* (no rates or duty), about 4½ per cent.
								131.7	183.7	58.3	326.3	
Philadelphia & Reading	5 "	"	95	332	6.	44.	$1.04	19.5	30.5	10.1	49.9	

REMARK ON TABLE IV.—*Average Number of Daily Trains.*—This column was computed, including the full length of branches, instead of "equating" their length in proportion to business transacted, as in Table I. On the other hand, the returns presumably include construction as well as revenue trains, which is not the case in Table I.

The cost per train mile was converted into Federal money at 2 cents per penny.

TABLE V.

Showing the Percentage of the Various Items of the Cost of Maintenance of Way, for a series of years, on different Railways and from State Reports.

NAME OF ROAD.	No. of years averaged.	Dates (inclusive).	Statistics for last year. Length. Main Line.	Branches.	Av. No. of daily trains. Passenger.	Freight.	Cost of Maintenance of Way per train mile.	Percentages. Track and Roadbed. Renewal of rails.	Ties.	Earthwork, Ballast, etc.	Track Surfacing.	Switches, frogs and sidings.	Total.	Structures. Bridges and Bridge Masonry.	Buildings.	Wharves and Machinery.	Total.	Grand total.
Pennsylvania	2 years.	1867–71	358	426	11.	32.8	$0.25	30.1	9.8	15.7	28.8	2.6	56.9	....	....	....	13.0	100.
Philadelphia & Reading	3 "	1868–70–73	95	332	6.	44.	0.26	23.8	11.5	5.4	28.8	8.	53.7	6.2	7.6	8.7	22.5	100.
Louisville & Nashville	3 "	1871–73	185	207	3.1	6.5	0.41	39.3	13.4	8.4	18.8	4.1	44.7	8.2	7.8	....	16.	100.
Illinois Central	8 "	1865–73	456	250	3.	7.	0.275	25.	12.	21.	.2.	7.	62.	12.	1.	....	13.	100.
New York State Railroads	5 "	1870–74	6,574	1,977	3.5	8.4	0.28	30.5	....	....	....	....	54.5	7.	8.	....	15.	100.
Massachusetts State Railroads	5 "	1871–75	2,459	.....	7.4	6.7	0.30	24.5	....	....	....	....	54.1	7.3	14.1	....	21.4	100.
Averages								28.9	11.7	12.6	24.6	5.4	54.3	8.5	8.3	....	16.8	100.
Corresponding percentage which each item forms of the *aggregate cost of a train mile*, allowing the aggregate cost of Maintenance of Way to be 27 per cent. of said cost, as shown in Table I.								7.8	3.2	3.4	6.6	1.5	14.7	2.3	2.2	....	4.5	27.
Do. do. as adopted for the purposes of this paper								7.	3.	4.	6.	3.	16.	2.5	1.5	....	4.	27.

REMARK ON TABLE V.—In compiling the table, it was found impossible to determine the cost of sidings separately, except on the Philadelphia & Reading Railroad. It was also impossible to separate the cost of maintenance of shops from other buildings entirely. Hence, the column of "Switches and Sidings," in fixing the last line of percentages in the table, was increased from the columns of "Rails," "Ties," and "Track Surfacing," by a percentage of about 1-10 in each case; and the column of "Earthwork, Ballast, etc." (which includes culverts and ditches), was increased from the column of "Buildings."

a period of 24 years. It is given in full, although only a portion of it is required for our present purpose, as an interesting resume of the history of a leading railroad. It will be observed that the relative cost of maintenance of way has slightly but steadily *increased* for a period of 24 years (in almost exact proportion to the weight of engines), while at the same time the relative cost of the direct running expenses has somewhat decreased; the volume of business, measured by the standard of the train mile, having more than doubled during the period included; and as measured by tons transported, increased five-fold. And it must be remembered that this table, as in the case with the English railways, in Table IV., does *not* include the cost of renewing rails, but only the care and maintenance of road-bed and track.

As evidence that the experience of the Philadelphia & Reading Railroad is not exceptional, the following table shows the relation of the cost of maintenance of way to the cost of locomotive charges on the Great Northern Railway of England, for a period of 23 years. The first and third columns are taken from the paper before referred to by Mr. R. Price Williams, "On the Maintenance and Renewal of Permanent Way," (Trans. Inst. Civ. Engrs., 1866); the remainder of the table was added by the writer.

If the final column of Table VII. be examined, it will be observed that, barring a slight irregularity at the beginning of the table, when the works were new and entailed little expense (the railway was opened for business in September, 1850, and new *English* railways are in very perfect condition), the cost of maintenance of way bears a singularly uniform but slightly increasing ratio to the cost of locomotive power for a period of about 20 years, during which period the volume of business, measured by the number of daily trains, was considerably more than doubled. We thus have a very close parallel to the experience of the Philadelphia & Reading Railroad.

Mr. Williams was evidently struck by the fact that no evidence of relative decrease in the cost of maintenance of way as business increases was apparent in this table and others of his paper, for he makes the following comments thereon:

"It must be confessed that the condition of the permanent way, so far as regards its durability, has in no way kept pace with the demands made upon it, and in this respect it contrasts most unfavorably with the marked progress observable in other branches of railway engineering. Taking the improvement in the modern locomotive as an illustration, it will be found that while its weight and power have in 30 years increased more than four-fold, the increased efficiency resulting from better workmanship and material is such that the percentage of the locomotive charges on the gross traffic receipts of the Great Northern Railway has even slightly decreased during the last fourteen years, while the percentage on the gross traffic receipts of the cost of maintenance of way has increased more than 200 per cent."

In this statement Mr. Williams has somewhat exaggerated the facts of the case, owing to the not uncommon fallacy of drawing conclusions from the top and bottom of a table which the body of it does not sustain. The percentage of the cost of maintenance of way *appears* to have increased "over 200 per cent" only on account of the exceptional and unduly small cost of that item in the first 2 or 3 years of the table. Nevertheless, the fact remains that, omitting those earlier years, the cost of maintenance of way has borne a constant and slightly increasing ratio to locomotive or train expenses during a long period of rapid increase in business. But that Mr. Williams' explanation of the *cause* of this fact, (viz., exceptionally great improvements in the locomotive and other branches of railway engineering) is entirely in error, and that it is due to a fixed law of relationship and not to temporarily greater progress in one department than another, seems evident from the fact that precisely the same facts have continued since 1865, during which period no considerable changes or improvements in the locomotive engine have occurred, nor have the demands upon the permanent way been increased in respect to high speeds and heavy engines. And a still better evidence of the fallacy of his reasoning is that the same nearly constant ratio between maintenance of way and train expenses is noticeable in the operation of neighboring roads operated with the same rolling stock but varying in the volume of business. Tables I. to IV. have been already referred to as illustrating this fact, and the following table (Table VIII.-A), compiled from the Massachusetts State Reports, still further illustrates it. It will be observed that the roads of greatest business have also the greatest cost *per train mile*, for maintenance of way. Table VIII.-B is a similar table for New York State and shows the same fixed ratio of expenses under varying business as is shown in Table VIII.-A.

Other facts of a similar nature might be adduced, did not space forbid; noticeably the admirable colored diagrams which accompany Mr. Williams' paper and at once illustrate to the eye the following facts:

1st. That all the main items of expense continue in an approximately constant ratio to each other as business increases.

2d. That *none* of the items of expense, not even locomotive charges, increase quite in proportion to train mileage, and, in a very marked degree, increase less rapidly than the tonnage.

Facts from so many independent sources would seem to make evident that either the cost of track maintenance proper must increase considerably *faster* than the train mileage, which is unreasonable; or that the remaining expenses for maintenance of way, which are apparently independent of train mileage, must increase nearly in proportion. At least it cannot lead us into great error to assume this to be so, for the purposes of solving problems of location, however it may be for the determination of freight rates and similar questions which arise in the operation of railways, and require in many respects a different classification of expenses. It would lead us too far to attempt any explanation of this singular constancy of ratio, but all the facts seem to indicate that a larger increase than is commonly assumed in the expenditure on such items as ditches, ties, bridges, earthwork and masonry, is absolutely essential for the exigencies of a large business, although it is not advisable for a smaller one; or at least that experience proves it to be *economy*, whether it be absolutely essential or not, to expend an amount increasing in equal ratio with the cost of running trains on the perfection of the road-bed and track. A further reason is, that even the direct train expenses do not increase nearly as fast as the volume of business, even if measured by the standard of the train mile. Comparisons of main line and branches are hardly a fair test of this question, as before stated, because the general operating expenses are almost uniformly less than if the branch were independently operated, and the expenditure on maintenance of way almost as uniformly greater.

TABLE VI.

Giving the Percentages of Various Items of Expense and other Statistics on the Philadelphia & Reading Railroad during a period of 24 years.

DATE.	Length of road.	Length of single track.	Miles run.	Cost of transportation. Per ton, coal.	Per ton, freight.	Per train mile.	Trains daily, excluding Sundays. Over road.	Over single track.	Average tons of coal per train.	Percentages of expense. Maintenance of way.	Repairs, engines.	Repairs, cars.	Running station and general.	Rent, taxes, etc.	"Total expenses."	Per cent. of cost of iron to "total expenses."	Tons from renewed per train mile.
	Miles.	Miles.		Cts.	Cts.	Cts.											
1850	95	95	1,223,000	41	67	87	20.8	10.4	372	14.4	15.0	7.1	50.2	12.4	100.	1.1	.00084
1851	95	95	1,462,000	39	69	81	24.6	12.3	368	13.4	13.7	8.2	51.7	13.	100.	2.2	.00071
1852	98	98	1,518,000	35	78	91	24.9	12.5	366	16.4	14.	8.	49.2	12.4	100.	2.	.00087
1853	98	98	1,467,000	35	77	84	24.3	12.2	384	14.6	13.4	9.8	48.5	13.7	100.	3.	.00106
1854	98	98	1,674,000	41	82	97	27.3	13.7	409	13.4	15.7	13.	45.9	12.	100.	4.1	.00136
Average, 1850-54	96.8	96.8	1,470,800	38.2	74.6	86	24.4	12.2	379	14.4	14.5	9.2	49.2	12.7	100.	2.5	.00091
1855	98	98	1,948,000	34	80	92	31.9	16.	423	16.5	12.7	11.6	46.6	12.6	100.	9.3	.00255
1856	98	98	1,942,000	35	68	97	31.8	15.9	412	17.8	18.	11.3	43.9	14.4	100.	11.3	.00366
1857	98	98	1,707,000	36	69	86	28.	14.	411	18.	12.8	13.4	46.2	9.6	100.	8.7	.00283
1858	98	152	1,570,000	28	63	76	16.5	10.1	422	18.6	11.	12.6	48.0	9.8	100.	8.6	.00274
1859	98	152	1,702,000	23	48	75	17.9	10.8	436	18.2	10.8	12.	47.8	11.2	100.	8.1	.00196
Average, 1855-59	98.	119.6	1,773,800	31.2	65.6	85.2	25.2	13.4	421	17.8	12.1	12.2	46.4	11.5	100.	9.2	.00275
1860	98	152	1,852,000	22	39	79	19.5	11.8	443	16.5	11.3	10.8	44.8	16.6	100.	7.8	.00230
1861	98	152	1,696,000	21	46	76	17.9	10.8	436	19.2	10 9	10.4	44.5	15.0	100.	6.7	.00206
1862	98	152	2,088,000	18	36	74	22.	13.3	457	16.7	12.3	8.6	42.8	19.6	100.	4.	.00130
1863	107	152	2,722,000	22	38	94	28.6	16.8	514	14.5	13.4	7.9	41.3	22.9	160.	3.7	.00140
1864	126	152	3,328,000	30	46	138	35.	19.1	487	15.8	13.	9.	37.2	26.	100.	4.7	.00187
Average, 1860-64	105.4	152.	2,337,200	22.6	41.0	92.2	24.6	14.4	461	16.5	12.0	9.3	42.2	20.0	100.	5.4	.00179
1865	130	152	3,688,000	40	54	160	38.8	20.9	462	17.	13.	10.9	35.8	23.3	100.	3.3	.00142
1866	133	152	4,261,000	36	44	147	44.9	23.4	471	17.5	11.7	19.6	39.8	21.4	100.	4.	.00201
1867	133	152	4,356,000	37	41	152	45.9	24.4	458	18.4	12.9	10.1	39.6	19.	100.	4.4	.00198
1868	133	152	4,500,000	35	39	125	47.2	25.3	449	19.	11.7	10.3	41.2	17.8	100.	5.9	.00251
1869	139	152	5,159,000	33	38	121	54.	28.3	467	18.	12.9	9.2	41.5	18.4	100.	5.2	.00233
Average, 1865-69	133.6	152	4,392,800	36.2	43.2	137.	46.2	24.5	461	18.0	12.4	10.0	39.6	20 0	100.	4.6	.00205
1870	139	152	5,100,000	32	29	115	53.5	28.	474	19.1	11.6	7.3	42.3	19.7	100.	5.1	.00279
1871	151	260	6,543,000	27	21	105	40.1	25.5	512	18.4	12.3	6.2	41.4	21.7	100.	4.9	.00234
1872	151	323	7,249,000	27	21	101	35.9	24.5	521	19.1	12 6	6.4	42.3	19.6	100.	5.6	.00227
1873	151	327	8,352,000	27	26	104	40.8	28.	512	19.4	12.3	5.7	44.6	18.	100.	6.8	.00220
Average, 1870-73	148.	265.5	6,811,000	28.2	24.2	106.2	42.6	26.5	504	19.0	12.2	6.4	42.6	19.8	100.	5.6	.00240
Average, 1850-73	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.14	12.54	9.42	44.0	16.80	100.	5.46	.00208

REMARK ON TABLE VI.—No correspondence whatever must be expected between the percentages given above and those given in Table I., as the renewal expenses are not included in the above table. One expenditure from the renewal fund, however, is given above, viz.; the cost of renewing worn out iron, amounting to an average of 5.46 per cent. of the returned total expenses.

The number of daily trains was computed allowing 313 days in the year, instead of 325, as in Tables I. to IV.

It will be observed that the wear of iron for the past 20 years averages about 4.7 lbs. per train mile, which, allowing an average of 65 lbs. for the heavy rails in use on that road, gives something less than 50,000 trains as the life of a rail; or, allowing the average weight of all trains to be 500 tons (passenger trains being allowed double weight), 25,000,000 tons passed over it wears out a rail. On the Louisville & Nashville Railroad, during the 18 years, 1855-74, the average wear of rails was .00024 per train mile (deduced from Table XIX., Report of 1873-4), closely agreeing with the above, but the average weight of trains on that road was only 314 tons, instead of at least 500 tons. Something less than 40,000 trains on the latter road wore out a 60-lb. rail, equiva.ent to 42,500 trains for a 65-lb. rail: giving as the tonnage life of a rail, about 12,560,000 tons for a 60-lb. rail, and 13,350,000 lbs. for a 65-lb. rail. These comparative results, after making all allowances for the probable inferior quality of the Louisville & Nashville rails, would seem to indicate that it is the engine mileage more than the tonnage which measures the life of rails.

N. B. These statistics for the Louisville & Nashville Railroad do not exactly agree with those given in the table above referred to, inasmuch as revenue trains only were there included in the corresponding deductions to those above.

TABLE VII.

Showing the Ratio of the Cost of Maintenance of Way (Renewals not included), to Locomotive Charges on the Great Northern Railway of England, for a period of 23 years:

YEAR.	Percentage of locomotive charges On gross traffic receipts.	On gross traffic expenses.	Percentage of maintenance of way On gross traffic receipts.	On gross traffic expenses.	Percentage on locomotive charges of maintenance of way.
1851	17.19	.....	4.09	.....	24.
1852	14.24	.....	4.80	.....	34.
1853	13.87	.....	5.61	.....	41.
1854	15.40	.....	8.21	.....	54.
1855	16.50	.....	7.76	.....	48.
Average	.....	.....	.....	.....	40.3
1856	15.40	25.2	8.21	13.4	53.
1857	15.11	.....	9.73	.....	64.
1858	16.01	.....	9.32	.....	58.
1859	14.83	.....	9.59	.....	64.
1860	15.30	26.7	9.86	18.5	64.
Average	.....	.....	.....	.....	60.6
1861	15.21	.....	9.27	.....	61.
1862	15.13	.....	9.10	.....	60.
1863	14.58	.....	10.23	.....	70.
1864	15.26	.....	10.42	.....	67.
1865	16.94	.....	9.99	.....	58.
Average	.....	.....	.....	.....	63.2
1869	.....	27.2	.....	18.2	67.
1870	.....	26.5	.....	18.6	70.
1871	.....	26.4	.....	18.9	71.
1872	.....	27.8	.....	18.7	68.
1873	.....	30.4	.....	19.	62.
Average	.....	.....	.....	.....	67.6
General average	.....	.....	.....	.....	57.9

REMARK ON TABLE VII.—The writer did not have the data accessible by which to continue the table for the later years in the same form as for the earlier ones, but percentages on gross expenses evidently serve the same purpose as percentages on gross receipts for determining the ratios in the last column.

SUMMING UP THE PRECEDING CONCLUSIONS,

we may assume, on the authority of Tables I. to V., that the following percentages represent very closely the *relative* cost of the various items of expense which enter into the operation of railways, taking the average of years; and that this relative cost or percentage is much less liable to fluctuation than the actual expenditure in dollars and cents:

Classification of Operating Expenses.

TRAIN EXPENSES	43 p.c.	Engines	21 p.c.	Fuel 10 p.c.; Oil, Waste, etc. 2 "; Repairs 9 "
		Cars	10 "	Repairs, inspection, etc 10 "
		Train Hands	12 "	Eng'eman and Firemen 6 "; Conductor and brakemen 6 "
MAINT'CE OF WAY	27 "	Track	13 "	Renewal of Rails 7 "; Adjust'g track, etc 6 "
		Roadbed	7 "	Ren'al of Ties. 3 "; Earth'k, Ballast, etc 4 "
		Yards and Structures	7 "	Switches, frogs and Sidings 3 "; Bridges and Br. Masonry 2.5 "; Station and other Build'gs 1.5 "
TOTAL "LINE" OR "TRANSPORTATION" EXPENSES	70 "		70 "	70 "
Station, terminal and general expenses and taxes	30 "		30 "	30 "
TOTAL OPERATING EXPENSES	100 "		100 "	100 "

These percentages we have seen to be most liable to variation in the items of "Station and General Expenses," but that the items of line or transportation expenses in such cases will still preserve, as a rule, a nearly constant ratio to each other, as above; the item of fuel being the most liable to irregular fluctuations.

If we assume, for even figures, the low average of $1 as the cost of a train mile (*i. e.*, 70 cents per train mile transportation expenses proper), these percentages will also represent the cost of the renewal items, per train mile, in cents; and inasmuch as we have seen them to apply as percentages, within a small margin of error, to 13 representative roads and four State averages, we may use formulæ or values so obtained, without serious error, for any other cost per train mile, assumed or actual, by simply multiplying by such cost, without necessary consideration in each case of each separate item.

We have also seen that these percentages are but little affected by the volume of business, in the items with which we are most concerned, and are hence equally applicable to roads

TABLE VIII. A.

Showing the Cost of Maintenance of Way per mile of road and the cost per train mile for different items thereof, on Massachusetts Railroads of varying business.

YEAR.	Eight Boston Roads.				Other Mass. Roads.			
	Aggregate cost of maint. of way per mile of road.	Cost per train mile.			Aggregate cost of maint. of way per mile of road.	Cost per train mile.		
		Road repairs.	Renewal of rails	Total cost per train mile.		Road repairs.	Renewal of rails	Total cost per train mile.
1872	$3,380	.167	.089	1.32	$2,300	.176	.094	1.30
1873	3,662	.200	.073	1.284	2,155	.169	.099	1.342
1874	2,757	.163	.087	1.198	2,505	.137	.060	1.253
1875	2,489	.157	.058	1.150	2,293	.144	.044	1.220
Average	$3,077	.1716	.0773	1.238	$2,313	.1550	.0742	1.279

	8 Boston Roads.	Other roads
Percentage on Total Expenditures of Road Repairs	13.9	12.1
Percentage on Total Expenditures of Renewal of Rails	6.2	5.7
Ratio of Cost of Road Repairs to Wear of Rails	2.22	2.10

REMARK ON TABLE VIII.—In the last two years above the "other Massachusetts roads" given in the reports include only a few representative roads doing a larger average business than the roads omitted. Consequently, the contrast in the volume of business between the "Boston roads" and the "other roads" is less striking than in the first two years or than it would otherwise have been, although the table clearly indicates that the result would have been the same. For the year 1872 (Report of 1873) the Boston roads are not separated from the others in the reports; otherwise the statistics are exactly as given in the State reports.

TABLE VIII. B.

Showing comparative Statistics of the Cost of Maintenance of Way on al the Railways of the State of New York and on the 4 railways therein having the greatest volume of business. For the year 1873 and for freight business only.

	Freight earnings.		Expenses, per freight train mile.	Cost of maint. of way per train mile.		Perc'ntage of total fr't expenses.	
	Per mile of road.	Per train mile.		Roadbed & track only (excepting iron).	All expenses (including taxes).	Roadbed & track only (excepting iron).	All expenses for maint. of way.
Average of all the railways of the State	$7,620	$1 50	$1.054	15.3 cts.	26.8 cts.	14.5	25.4
Average of 4 leading railways, viz.:							
N.Y. Cen. & H. R.							
Erie							
Lake Shore & Mich. So.	$26,642	$1 69	$1.181	15.7 cts.	30.0 cts.	13.4	25.4
Boston & Albany							

REMARK.—These statistics are for freight only, as being easier to compile; but the expenses as alloted to "passenger and freight business" in the New York State Reports differ but little either in the aggregate amount per train mile or in the percentage chargeable to the various items of expense.

The four great roads above vary but little from each other in volume of business (viz., from $23,000 to $30,000 freight earnings per mile), and the average of $26,642 per mile exceeds by nearly $20,000 per mile that of any other railways of the State. As their aggregate receipts amount to four-fifths of those of all the railways of the State (viz., $51,800,000 out of $65,100,000), and their length to only three-eighths (viz., 3,382 miles out of 8,552), the contrast in the above table would have been much more striking had the business of the four great roads been excluded from the general aggregate. For example, the freight earnings per mile of road for all the other railways of the State would have been only $2,380 per mile, instead of $7,620; yet it is obvious that the comparison in the latter part of the table would have been inappreciably affected.

of either a large or a small business; at least sufficiently so for the solution of the various problems of location, which we will now proceed to consider.

[*To be continued.*]

RAILROAD LAW.

Municipal Aid in New Hampshire.

In Perry and others against the City of Keene, the New Hampshire Supreme Court held:

1. The laying of taxes is a legislative function, and the policy and expediency of it, as well as its amount, are questions exclusively for that department of the State. There is no abstract legal principle by which to determine whether a use is public; a court must decide it as a conclusion of fact and public policy, in the same manner as the Legislature. Hence, while it is clearly the duty of a court to determine finally what is a public purpose, it will only decide adversely to the judgment of the Legislature in a clear case.

2. If a purpose is public, it makes no difference that the agent by whom it is to be carried out is a private individual or corporation.

3. The building of a railroad is a public purpose; and a statute authorizing a town to vote money to aid in such purpose, even though the money is to be given as a *gratuity* and not as a subscription to stock, is not unconstitutional as a taking of private property for a private use.

Carriers' Liability for Negligence.

In Jewell against the Grand Trunk Company, the New Hampshire Superior Judicial Court held:

1. Common carriers are bound to deliver freight, consigned to them for transportation, at a place suitable and reasonable for the consignee to receive it, and whether any given place answers this requirement is a question for the jury, under proper instructions from the court.

2. The rule would be the same if their liability as common carriers had ended, and the goods remained in their possession as warehousemen or depositories.

3. The liability of a master for the negligence of his servant extends only to such acts or omissions as come within the scope of the servant's employment. Therefore when the servant of a railway corporation, not having authority from the corporation to employ other servants, engaged one G. to assist him in moving a crate of crockery, and through the negligence or inefficiency of G., combined with the carelessness of the servant, the crate was overturned, striking the plaintiff, whereby he received a severe injury, *Held*, that the corporation was not liable for the negligence of G., nor for the fault of their servant in employing G. to assist him, even admitting G. to have been an unsuitable and improper person to engage for that service.

4. If the consignee of goods accepts a delivery at a place or in a manner different from what a common carrier is liable by law to deliver them, the business of removing them becomes from that time his business, and the carrier cannot be held liable for the acts or omission of those employed to do the work.

5. When the duty of a common carrier as to the delivery of freight has ended, no custom or practice of his servant in assisting consignees in moving or loading their goods can affect the principle.

Subscriptions to Stock.

In the Northern Central Michigan Company against Parker, appeal from the Calhoun Circuit, the Michigan Supreme Court holds as follows:

Where the general railroad law had provided that subscriptions for stock in a railroad company must be taken upon books opened by commissioners, it was held that subscriptions otherwise made could not be enforced unless made on some actual consideration or agreement binding the company.

A declaration upon a subscription for railroad stock must allege the agreement between the company and the subscriber, to be either complete or to be made so by subsequent acceptance, and the allegation must be proved to sustain the action.

In an action upon a subscription, irregularly made, for railroad stock, possession of the subscription paper by the corporation, long after the suit began, would not of necessity raise the presumption of reasonable liability on it, as if it had been only delivered by the commissioners to the corporation.

THE SCRAP HEAP.

Railroad Manufactures.

The Danville (Pa.) Iron Works are so busy that a contract for 300 tons of iron rails had to be turned over to the Co-operative Iron Works, of the same town.

The Stewart Iron Company, at Sharon, Pa., is shipping large quantities of Bessemer pig iron to the Edgar Thomson Steel Works.

Emans Furnace, at Emans, Pa., was to go into blast Sept. 1.

The Cambria Iron Company, at Johnstown, Pa., makes a general reduction of all wages and salaries, Sept. 1.

The Indianapolis Rolling Mill is rerolling a large lot of rails for the Indianapolis & Vincennes road.

Porter, Bell & Co., at Pittsburgh, recently shipped four engines, two of 9 tons and two of 6 tons each, to a street railroad in New Orleans. Their works are running nine hours per day, with a slightly reduced force.

The National Tube Works, at McKeesport, Pa., Spang, Chalfant & Co., and Evans, Dalzell & Co., of Pittsburgh, have heavy orders for 4-inch lap-welded iron pipe for the Pennsylvania Transportation Company.

The Ironton (O.) *Commercial* says: "Mr. James J. Thomas has shown us a section of a perfect T rail, recently rolled in the Lawrence Mill, which weighed about ¾ pound to the yard. It is probably the smallest rail ever rolled."

A company has been organized to build a new blast furnace at New Geneva, Fayette County, Pa. Coal, ore and limestone are all found close to the furnace site.

Harris & Co., at St. John, N. B., are building several passenger cars for the Elgin Branch Railway.

The Louisville Bridge & Iron Company has the contract for a wrought-iron trestle 570 feet long and 78 feet high over Fishing Creek on Section 59, Division D, on the Cincinnati Southern road, and the contract for a wrought-iron bridge and trestle 400 feet long and 59 feet high over Pitman Creek on Section 82, Division E, of the same road.

The Barney & Smith Manufacturing Company at Dayton, O., are full of work, employing a full force and having contracts extending into December, among which are eight coaches, 12 baggage cars, 200 box, stock and flat cars for the Columbus & Toledo; 220 freight cars for the St. Louis, Kansas City & Northern; five coaches and two baggage cars for the Lafayette, Muncie & Bloomington; two parlor cars for the Ohio & Mississippi; a combined baggage and passenger car for the Milwaukee, Lake Shore & Western; seven coaches and 50 freight cars for three different narrow-gauge lines, and other contracts. Four narrow-gauge passenger cars were recently shipped to California.

J. M. Jones & Co., at West Troy, N. Y., are finishing up an order for 20 passenger cars for Kingston, Jamaica. They have also under construction a few street cars for Canada, a large order for Europe, and orders for Syracuse, Buffalo and the Seventh Avenue line in New York.

The Vulcan Iron Works, at St. Louis, have an order for 5,000 tons of steel rails for the Central Pacific.

The Cleveland (O.) Iron Company's mill is running on rails and merchant bar.

The Girard Rolling Mill Company, at Youngstown, O., reported a handsome profit from last year's work at the recent annual meeting.

The Arlington Car Manufacturing Company, of Arlington, Vt., has suspended, with liabilities of about $50,000.

Port Oram Furnace, in Morris County, N. J., is to go into blast about the end of September.

British Rail Exports.

For July and the seven months ending with July the exports of railroad iron of all sorts were:

	1876.	1875.	Decrease.	P. c.
July:				
To the United States	68	1,814	1,746	96.3
To all countries	41,702	71,601	29,899	41.8
Seven months:				
To the United States	418	3,288	2,870	87.3
To all countries	223,327	330,908	107,581	32.5

Sweden and Norway are the largest customers this year, closely followed by British North America and British India. More than a third of the whole went to British dominions.

A Good Engine Record.

The Hornellsville (N. Y.) *Times* says: "Engine 223 of the Erie, is a passenger engine, 18 by 22 in. cylinders, 5¼ ft. drivers. Total weight 77,300 pounds. She was rebuilt at the Brooks Locomotive Works and placed upon the Western Division in October, 1870, in charge of Josh Clark, one of the Erie's most reliable engineers.

"From October, 1873, to June 30, 1876, she ran 178,989 miles, during which time there was not a cent expended for repairs on cross-heads, nor were the brasses in forward end of main rods filed. And the engine is in a fair way of doubling the above mileage before she will have to go to the shop for repairs."

Railroading in Russia.

The Springfield (Mass.) *Republican* of Aug. 16 says: "Mr. John McFethries, 11 years Master Mechanic of the Kursk, Charkoff & Azof Railroad in Russia, has returned to Springfield with his wife, and gives interesting facts about Russian railroading. This road is a single-track concern, 500 miles long, running from Kursk to the port of Tagonrog on the Azof sea. The gauge is five feet, with an equipment of 225 passenger and 3,500 freight cars, 200 engines, and four locomotive and repair shops, with from 1,500 to 2,000 employes, according to the season. Only 46 engines are of American make, from the Grant Works at Paterson, N. J., and the coaches, of continental manufacture, are peculiar in pattern, opening at the ends, with a middle aisle as here, but only 34 feet long, and, instead of having four or six-wheeled trucks, three single wheels on each side of the car are attached directly to the car string-pieces, equi-distant, and not connected with each other. Four wheels suffice for a freight car.' American coaches are almost unknown, only one car, a Pullman, from England, having been run over the road on an exhibition trip. But palace cars are liked by the authorities, and Mr. McFethries thinks they will be soon in use, though the royal family may for a time monopolize them. The Kursk, Charkoff & Azof road, while nominally a corporation, is really run by one Pollykoff, a Russian 'Tom' Scott, controlling 1,500 miles of road, and never letting-on about net earnings, publishing only gross earnings, which, for this road, are roughly estimated at 6,570,000 of roubles, about $4,927,500. The daily passenger traffic is about 1,500. The daily wages of mechanics vary from 60 copecks to 1¼ roubles, or 45 cents to $1.12 in our money, while laborers get but 40 or 50 copecks, and wages are paid, not in coin, but in greatly depreciated paper money. Of politics, mechanics are kept in the dark, and they know better than to seek illumination. Not long since, 18 men at the Harkoff repair shops, together with 40 university students, 'were wanted' by the secret police for holding covert political meetings, and where the unfortunates afterward went, the Lord only knows. However, as long as railroad men let the 'political machine' alone, they find Russia a reasonably free country. But secret cancuses, whether for packing primaries or other political sports, are regarded by the government with an adverse eye, just at present."

An Absent-Minded Conductor.

The Newburg (N. Y.) *Journal* of recent date says: "One of the most extraordinary cases of absent-mindedness on record is that which, we are told, occurred a day or two ago to Conductor George Kisselbrook, on the Dutchess & Columbia Railroad. His train arrived at Millbrook, going east, at its usual time, and the conductor, as usual, politely assisted his lady passengers to alight, and those intending to take his train aboard. He then gave the engineer the signal to start, and after so doing stepped back and took a seat on the stoop of the depot. There he coolly remained, and as composedly watched his train haul away from him. Before he realized his predicament the train was half a mile off and around the curve. He then exclaimed, 'Oh, thunder! I am left by my own train!' and sure enough he was. He then hired a wagon and was driven over to the Harlem Railroad, where he took a train for Millerton. This was a speedy route for him to take, as he arrived at Millerton at 8:20 P. M., instead of 12:35 P. M., the time for his own train to arrive. As Superintendent Kimball, who is an old conductor, happened to be on the train, it proceeded on without any detention or difficulty. The cause of George's absent-mindedness just as the train moved away from Millbrook is said to be the sudden recollection of a little sport he once had while picking cherries with some young ladies. He became so interested in thinking of the occasion that he became oblivious of everything that was going on about him."

Fast and Slow Time.

The Burlington *Hawkeye* says: "A party of Burlingtonians were coming down on the Burlington, Cedar Rapids & Minnesota the other night, when they got to discussing the speed of railway trains. One young man, who had travelled 55 miles an hour on the Lake Shore road, and rode 68 miles an hour on the Hudson River Railroad, and once went on an engine that went 83¾ miles in 64 minutes, 17¼ seconds, expressed the greatest contempt for the time the party were then making on the Burlington, Cedar Rapids & Minnesota, and finally bet a keg of beer that he could jump off the front platform of that car and climb on to the rear one again. They took up his bet and he jumped off. There is a great degree of unanimity in the evidence on the point that he alighted on his feet, but there is some diversity in regard to the length of time he remained on them, different and equally trustworthy witnesses putting it at one-sixtieth, one hundred and twentieth, and one five hundredth part of a second, while on the questions regarding the number of summersaults he turned and the different distances he walked on his hands before he finally flattened himself up against a pile of ties three hundred yards away from the track, the testimony is so varied that no reliable data can be obtained. The testimony of the young man himself is to the effect that when he got back to the track and began feeling for that rear platform, the rails were cold, the silence very painful, and he was informed by a passing granger that the last train had gone down three hours before. He has since paid for the beer."

The Springfield Iron Company.

The fiscal year of the Springfield Iron Company closed with July 31. The business of this company is the making of iron rails exclusively. Up to 1st of January last none were made of less weight than 50 lbs. per yard. Now they are made as low as 30 lbs. The make of rails this year was 21,783 gross tons against 22,740 tons for the year before. The reduced amount, however, is to be accounted for by the fact that 4,415 tons were light weights—mainly 30 lbs. per yard—for narrow-gauge roads. The largest production was in March, 1876, when 3,022 tons were made. Of these 332 tons were of 30 lbs. per yard and the balance 50 lbs. and over. The proportion of new and rerolled rails this year and last were as follows:

	1874-75.	1875-76.
New	11,563	12,448
Rerolled	12,877	9,335
Total	24,240	21,783

The pay rolls for the year have aggregated $209,496.68. Business was fair during the beginning of the year, but was very dull in November, December and January, the works having been in operation during those three months only 32 days in all. Since January the works have been in constant operation, and the year closes with a fair amount of orders in hand. Rails have lately been made for the Mobile & Ohio, the St. Louis, Rock Island & Chicago and the Covington, Columbus & Black Hills railroads, and orders are in hand for the Houston & Texas Western, the Waterville & Washington (extension of Central Branch Union Pacific) and the Grayville & Mattoon companies.

During the year the company has built and put in operation a boiler, blacksmith and machine shop, with carpenter and pattern shop attached. They have also completed a building 90 × 137 feet of brick with iron roof, in which they expect to erect Siemens-Martin furnaces for making steel. The plans for these furnaces, etc., have been prepared by Mr. A. L. Holley, and it is expected to have them in operation early next season. They will be on the "Pernot" plan, and the first of that kind built in this country. The company also has plans by Mr. Holley for a mill to contain a train of rolls for blooming ingots and one for making plates. These, with its present plant, will enable it to furnish steel or iron plates, steel or iron rails, axles and many other shapes. It is expected to get these new works in operation next season.

All of the heating and a part of the puddling in the company's works at present is done in the Siemens gas furnace. In the new works none other will be employed. Arrangements have also been made by which the iron rail piles may be "reheated," as is now done in several of the best mills in the country.

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Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

HYDROSTATIC MACHINERY.

It is to be regretted that the class or type of machinery in which the work is done by hydrostatic pressure is so very scantily represented at the Centennial Exhibition. A tolerably complete survey of the whole reveals but very few exhibits that can be thus defined.

There may be good reasons for this, however, one being, no doubt, the fact that in the United States we are only at the very beginning of the use of such machines, and another that foreign builders of them have made little or no pretence of exhibiting anything at all.

We have long been familiar with the hydraulic jack and punch, and with the more substantial press for wheels, cotton bales, and the like, but we most obviously need to study carefully the very wide range of application of which the simple element of water under pressure is capable.

It is little to our discredit, perhaps, that we have not thus far brought into use more fully the compact and powerful water-pressure engine, either in the simple reciprocating, or in the rotating form, for these are costly in themselves, and involve almost always the use of a prime mover of their own; that is, a pressure pump, in addition to the steam machinery which usually exists in any works before hand. Naturally enough, then, our manufacturers generally have preferred to extend their steam power, and not to venture into a field wholly new to them, and also so new to all our American machine builders.

This condition of things, however, ought to be now considered as past, and even though such things as hydraulic machines for forging, riveting, bending, punching, shearing, etc., are but imperfectly set forth at Philadelphia, yet no intelligent manufacturer can afford to neglect at least the consideration of the aid he may thus receive in his work from so powerful an ally as hydrostatic pressure.

Probably the most characteristic piece that could be named in this whole line of labor-saving appliances is the Tweddell hydraulic riveter. It is characteristic in that an enormous pressure is designed to be employed in it, from 600 to 1,000 lbs. per square inch, and also in that all the parts are very light in weight, and the whole is small in bulk, because of the small diameter of piston that it is found possible to use. It is indeed quite remarkable in that by strictly accurate construction the sizes of parts are all small, and the tool as a whole, with all its fixtures for adjustment, can be most perfectly set to its work, of whatever kind almost it may be.

Somewhat extended descriptions of the Tweddell hydraulic apparatus, of several kinds, have been published in England, and to some extent in this country, but the possibilities of its usefulness are far too little known and understood. It is plain enough that a costly tool of this description should be able, as this riveter unquestionably is, to deal with all the phases or varieties of its own proper work that are ever likely to occur in practice, while it may not be called upon for anything outside of that class of work. One objection to all hydraulic tools has been, and it is still urged, that they can do only one thing, and only one particular sort even of that; that they are so clumsy that only the rudest or most straightforward operations can ever be done at all with them; and thus, in the common mind, the whole idea of hydraulic working, even down to the simplest crane, exists as something quite impracticable, not to say mythical, and the entire art of doing the best things in the cheapest way is, in this respect at least, under a cloud, and years even behind its true place.

It is certain that, to one unfamiliar with such things, this Tweddell riveter will be a new revelation, and so would be the Brotherhood three-cylinder hydraulic engine, if it only were on exhibition. It may safely be said, simply as an abstract statement, and entirely apart from individual considerations, that this riveter is worthy of the most painstaking attention as a very perfect tool, both in respect to the excellence of its design, the accuracy of its construction, and the efficiency and completeness of its operation.

Of the Brotherhood engine, of which exceedingly little has been said or seen on this side of the water, it may safely be affirmed that it will help many things, or manufacturing operations, over hard places, and one of the least things that can be hoped for in connection with it is that the builders may very speedily get it firmly on its feet and out into use.

The Elevated Railroad Litigation.

The New York elevated railroads, which were so long in making a beginning, now find more artificial than natural obstacles, apparently. For years the question was what sort of a structure can be contrived that will not interfere with the traffic of the streets and yet afford a route for frequent and fast trains, at a cost such as will make it a reasonably profitable investment; again, a difficulty was, having found a practicable plan, to convince capitalists, in a time of general distrust of new enterprises, that they could safely invest money in such a road. Apparently both these obstacles had been overcome. One line has been tried enough to prove the practicability of an elevated road, and capitalists have been so well convinced that they have concluded contracts for two roads on one side of town and have begun work in earnest. But no sooner is the city offered what it has so long been clamoring for than some of its inhabitants make all haste to refuse it, invoking the aid of the law to protect their private rights, which they affirm to be invaded by the innovation. The New York Elevated, after succeeding in completing one track to Central Park and developing a considerable traffic over it, is fought at every step and delayed for months in its effort to construct a second track and extend its line a short distance where it obstructs no street in any manner. And now the Gilbert Elevated, when hardly begun, is met by a "permanent injunction" which threatens it with early death. This injunction, granted by the New York Supreme Court last Saturday, is put upon grounds which have not been advanced generally. The new constitution of New York prohibits special legislation for corporations. The elevated railroad companies received their charters under the old constitution, and these charters continue good, and the companies can proceed to do whatever their charters specially authorize them to do. The Gilbert Company was specially authorized to construct a railroad supported by arches arising from the curbs, leaving a space in the street at least 50 feet wide unobstructed. The authority to change this mode of structure for that proposed, with posts in the middle of the street 20 feet from the curb and 35 feet from each other longitudinally, is based on the "Rapid Transit Act" passed under the new constitution, and the action of the Commissioners under that act. By the terms of the act the Commissioners were authorized to determine the character of the structure permissible and to select a route; this they did, and their authority to do this the Supreme Court does not seem to question.

The Rapid Transit Act provided for the formation of a company to construct a railroad of such kind and on such route as the Commissioners might fix upon; but in another clause of the act the Legislature assumed to give to any previously chartered company the right to build such a road as the Commissioners should decide upon, if the route for which it had a charter should coincide with a route selected by the Commissioners. In this, Judge Sedgwick says, the Legislature exceeded its powers under the new constitution. *When* the route selected by the Commissioners happens to coincide with a route for which a company has a charter, the law virtually gives that company the prior right to build the road there, and that not such a road as it had the right to build under its charter, but such a road as the Commissioners had planned, which in this case was one limiting the public use of the street to a greater extent than the one for which its charter provided. This, the Court says, is special legislation, and therefore unconstitutional. The Gilbert Elevated Railway Company in this way is given greater privileges than were granted by its charter, and it is given them exclusively. The Legislature may have had authority to give the privileges, but not to any existing company, but only to one organized under a general law.

This decision covers a principle applicable to the other company also: both companies may construct such roads as their charters authorized, but may not avail themselves of any modifications in structure authorized by the Commissioners, if such modifications "involve a right to use a street different from the right to use a street given by the original charter." But the New York Elevated Company is authorized by its charter to build a structure similar to that which it has planned, though, perhaps, it has modified the position of part of it on the authority of the Commissioners. The Gilbert Company, however, will hardly undertake to build such a road as is described in its charter.

An appeal will be taken from the decision of the Supreme Court to the Court of Appeals, so that the question as regards the Gilbert road is not finally settled.

The great body of citizens who wish to be able to use a city steam railroad, and are not at all interested in the property on the routes, are apt to be impatient and vexed at these legal delays. It must be remembered, however, that these elevated railroads in cities are innovations. They certainly do affect the streets in which they are built and may affect the value of the property on those streets.

It is to be expected, then, that it will take a little time to establish the legal relations of the new occupant of the street to the old ones and the owners of property affected by it. It is not improbable that the proposed structures, which are much cheaper than any city steam railroads built heretofore, and have proved decidedly effective for city use, may come into use into many other cities, adding to the number of corporation uses of public highways, such as gas and horse railroad companies; and if so it is especially important that the legal questions should be well settled at an early day. Apparently, if it is not well settled in New York it will not be for lack of injunction suits.

The Relation of the Strength to the Form of Materials.

In the rooms of the Master Car-Builders' Association on Liberty street, New York, may be seen some specimens of rods with which Mr. Garey, of the New York Central road, has recently experimented. The results of the experiments are rather disturbing to some of the ideas which some of us have held, and will compel a general overhauling and correction of established theories. In the numerous discussions of the subject of the dead weight of cars, it has several times been proposed that the round rods used in the construction of cars should be thickened up on the ends on which the thread of the screw is cut, so that the effective diameter of the rod measured at the bottom of the thread would be the same as at the other parts of the rod. It was assumed that the rod, having less transverse section at the bottom of the thread, would be weakest at that point and would consequently break there. Nothing seems plainer, more obvious or more conclusive than this. The results of Mr. Garey's experiments, however, show how dangerous it is to draw such inferences, or rather to act on them without demonstrating them by experiment. He took three rods of $\frac{7}{8}$, $\frac{3}{4}$ and $\frac{5}{8}$ in. diameter respectively, and 3 feet long, and then cut a thread in the ends without upsetting them. The threads were of the U. S. standard sizes. On subjecting them to strains, instead of breaking through the screw, as they seemed in duty bound to do, each one of them broke near the centre. At the point of fracture, each of them was very much contracted in section, that is, was drawn down by the tension, as is always the case when soft iron is subjected to severe tensional strain. The following are the breaking strains and diameters of broken sections:

Diameter of rod.	Breaking strain.	Diameter at point of fracture.	Stretch of rod when broken.
⅞ in.	43,000 lbs.	9-16 in.	2¼ in.
¾ "	33,000 "	7-16 "	2⅛ "
⅝ "	24,000 "	⅜ "	2 15-16 in.

These experiments present an interesting problem, both theoretically and practically. It was stated by Mr. C. A. Smith, formerly master car-builder on the Erie Railway, that in practice the rods on cars almost invariably break

through the threads. Now if this is so, the problem becomes still more intricate, and its theory more difficult to explain. If the experience of other car-builders confirms the observation of Mr. Smith, the question then presents itself, why do such rods break at one place while in use on cars and at another in a testing machine. If, as we suspect, this is due to the quality of the material of which they are made, then it indicates anew the importance of testing carefully all the iron which is used so as to know its quality.

During the last few years our knowledge of the laws which govern the resistance of materials to stress has probably undergone, and is still undergoing, greater modifications and is being more rapidly extended than in any other department of engineering science. A very few years ago about all that was known was that different substances possessed certain properties of hardness, brittleness, toughness, etc., and that they would be torn apart, broken transversely or crushed if subjected to certain strains. The construction of the Brittania Bridge, and the experiments which were made to determine certain questions regarding its strength, and the investigations of Hodgskinson made our knowledge of the strength of iron more accurate, and established the fact that a large factor of safety was always necessary to make iron structures secure. About all that was then known was, in reality, what, in the days of the writer's apprenticeship, his employer was in the habit of embodying in the maxim —"if you must make a thing strong, it should be made damned strong." Good iron, it was found, would break if subjected to a tensile strain of from 50 to 60,000 lbs., but in practice it was not safe to expose it to strains of more than one-fourth or one-fifth as great. Some iron, it was found, too, would break off suddenly, while other was tough and ductile, and would bend and stretch, and undergo very considerable change of form before it would break. This was attributed entirely to the quality of the material, which was probably a correct inference within certain limits. Of late, however, investigations have been made to show the effect of the *form* of a piece of iron in resisting strains. This principle is apparent in the fact that a shaft, like a car axle, will bear more strain if the shoulders, when it is reduced in diameter, are made with a round instead of a square corner. In this case the form has the effect of distributing the strains in some way, which enables the material to resist them better than it can if the corners are square. It has also been shown by some investigator—although as we write we are not able to refer to the experiments—that by diminishing the size of a car axle between the wheels its strength may be increased. Doubtless this effect is due to the same cause that makes a well proportioned spring stronger than one which has too much material at one place and too little at another. When the latter is the case, the bending of the spring occurs at the weakest part, whereas if it is equally strong it occurs through the whole length of the spring, and there is much less flexure at any one point than if the spring is not equally strong throughout. It therefore often happens, though it seems Hibernian to say so, that a piece of iron may be made stronger by making it weaker, or rather lighter.

Kirkaldy pointed out a few years ago that "the breaking strain is materially affected by the shape of the specimen. Thus the amount borne was much less when the diameter was uniform for some inches of the length than when confined to a small portion—a peculiarity previously unascertained and not even suspected." That is, a rod of several inches or feet in length will have a lower breaking strain than a specimen of less than an inch in length at its smallest section. This has since been proved repeatedly by experiments.

Professor Thurston has recently pointed out that metals which are inelastic and "viscous," that is, which can be stretched or drawn out, will resist a greater strain if it is applied suddenly than if it is applied slowly. Now for this reason it may be that if the strain had been applied suddenly, as most likely it would be in practice in a car instead of slowly as it was in the testing machine, instead of breaking where the rods did, they would have broken through the threads, which apparently is their weakest point. Or it may be that if, instead of being made of very soft "viscous" iron, they had been made of iron which could not be drawn out so easily, and the section of which at the fracture would be less contracted by the strain, they would have broken at the screw instead of near the centre as they did. At any rate, it is evident that in calculating the strength of a bar of iron it is not alone the sectional area which must be taken into consideration, and that to form a correct idea of the capacity of any material to resist strains we must take into consideration its form as well as its size, and also the quality of the material, considered not only by itself but in its relations to its form, and their combined capacity to resist the strains to which it will be subjected.

Kirkaldy suggested that "the *working* strain should be in in proportion to the breaking strain per square inch *of fractured area*, and not to the breaking strain per square inch of original area." He has not given any proportion which these should bear to each other, but this method would probably establish a correct relation between the strains and the "viscosity" of the metal. That is, metal which becomes very much contracted before fracture and whose ultimate resistance is lessened thereby would not have so high a value assigned to it as a metal which would not contract so much.

A number of the ablest investigators are now engaged in this field of research, and it may and probably will ultimately be shown that our method of establishing some arbitrary "factor of safety" is in the highest degree a "rule of thumb," and that the only reason for doing so is to cover our own ignorance of the strength of materials and their power to resist strains. There are many skeptics now who have lost confidence in the limit of elasticity, the neutral axis, and a good many other dogmas which have been taught but not understood. There seems to be reason to believe that when we know accurately the resisting power of a material and then can tell to what strain such material will be subjected, under all the conditions in which it will be used, it will be safe to subject it to strains approaching very near to its ultimate strength. When the fact is kept in mind that nearly all structures are now made so as to bear at least four or five times as much strain as they will ever be called upon to bear, it will be seen that the economy which would be possible, should our knowledge advance far enough to enable us to know with certainty what materials can and will do, would create a revolution in engineering whose effects it is hard to estimate or anticipate. Progress in this direction must, however, be slow, and if the simple experiment of Mr. Garey will only lead others to go one or more steps further, our advancement will be quite as rapid as can be expected. Like the German poet and philosopher, what we ask for is "more light."

The Railroads of New York.

The report on railroads of the State Engineer and Surveyor of New York reached us this year Aug. 15, more than a month earlier than last year, yet ten months and a half after the close of the fiscal year (ending Sept. 30), which the report covers. We complained of the great delay last year, and we shall venture again to call attention to the fact that the value of the report to the community is greatly lessened—to many is almost entirely destroyed—by this late publication, which is not at all necessary. This report for 1874-75 was presented to the Legislature Feb. 29 last; and it probably would have been practicable to present it in print then. There are several parties concerned, all of whom can do something to advance the publication of the report. First, the railroad companies are apt to be in no hurry with their returns. The law requires these to be made to the State Engineer and Surveyor by Dec. 1; but out of 184 steam railroad companies, only 57 made their returns for this report as early as that date, 29 delayed till January, and 8 waited until the latter half of January, the last not being received until Jan. 22, by which time the Massachusetts report for the same period is usually printed. Of course, the State Engineer cannot make the bricks of his report without the straw of the companies' returns; whether he could have secured greater promptness from the companies, we do not know. Probably enough, as things go, the report would not be printed any the quicker if it were ready in December, so that there is no inducement to hasten its preparation. When once prepared and submitted to the Legislature, a resolution of the latter body must be waited for, we believe, before the printing is authorized; and then the State Printer takes his time to produce the book. During the session there are many documents for which members and others are clamoring: probably nobody clamors for the railroad report. The State Printer likes to have some work for the dull summer as well as the busy winter and spring, and the railroad report seems to be chosen as something that can wait. Perhaps if the people interested will join us in growling at this delay, they will at last succeed in getting the report in time to make it useful.

The chief facts contained in the report are summarized in the "abstract" at the beginning of the volume.

The companies make their returns, usually, for their entire mileage, both in and out of New York, it being hardly practicable to do otherwise. Thus the report includes the Lake Shore & Michigan Southern and the Atlantic & Great Western roads, though but a few miles, comparatively, of either are in New York. The entire mileage reported was 7,425.79, of which 5,499.28 miles were in New York. For two years the figures given by the successive reports are:

	1874-75.	1873-74.
Length of road laid	7,425.79	6,574.04
Double track and sidings	3,684.05	3,650.25
Length of branches	1,208.16	1,977.51
Double track of branches	155.02	305.97
Total length of track	11,264.75	12,507.77

The reader will find it hard to understand this perhaps. We are inclined to advise him not to try to. The companies seem to have had the same trouble in preparing their returns, and to have made them in various ways, according to their understanding.

Whether branches should be included with main line in the statement of "length of road laid" seems not to be settled. In the report for 1873-74, in the column whose sum is given as the "length of roads laid" sometimes branches are included and sometimes they are not, the result being, of course, that the total is useless. In the last report, apparently it was intended to include main lines and branches under this head, and the Erie is credited with 524.8 miles of road, instead of 459, as in the previous report. The head of the column, which in the earlier report (and always heretofore, we believe) read "length of road laid, in miles," is changed in the last one to "length of road laid in miles, owned." The changes and the addition of an entirely new "mileage table," in which the length is given of road owned under the heads of "Main Line," "Branches," and "Total Miles Built in New York State," make us hope that special effort has been made to have the new report correct; a corollary of which is that all previous reports are hopelessly wrong. The hope is modified by an appreciation of the difficulty of ascertaining the mileage from the returns made by the companies, some of which give only main line and some main line and branches as "length of road laid," while the two great companies, apparently despairing of guessing the conundrum as propounded in the form for the returns, have not filled the blanks at all, but given instead a long, detailed, minutely accurate and perfectly intelligible account of the roads owned and worked by them.

Evidently any comparison of the mileage, capital and operations for the two years based on the figures of the successive reports would be useless. Apparently the compiler has appreciated this, and endeavored to remedy the imperfections of the last report by the addition in the new one of a "comparative statement" (page 27) for two years, in which the figures for mileage and capital in 1873-74 (but not for earnings, expenses and traffic) are very different from those in the report for that year.

By this table the mileage and equipment for two years are reported as follows:

	1874-75.	1873-74.
Total miles of road	7,425.79	7,238.19
Miles in New York	5,499.28	5,210.88
Number of—		
Engines	2,730	2,566
First-class passenger cars	1,540	1,610
Second-class passenger cars	273	262
Baggage, mail and express cars	743	709
Freight cars	56,292	54,876

This gives for the last year one engine to 2.72 miles of road, one passenger train car to 2.90 miles, and 7.58 freight cars per mile of road—a heavy equipment. The increase in total mileage is 187.6 miles. The mileage within New York last year is not reported in the corrected table, and may be incorrect.

The cost of construction and equipment for the whole mileage is reported as $626,575,862, or $84,333 per mile of road, and about $28,000,000 more than for the previous year. Rolling stock is charged with $80,329,777 of the amount, or at the rate of $10,817 per mile. The stocks and debt are reported as follows:

	1874-75.	*1873-74.	Inc. or Dec.	P. c.
Capital stock paid in	$401,312,471	$402,365,071	Dec. $1,052,600	¼
Funded debt	310,999,903	291,681,017	Inc. 19,318,945	6½
Floating debt	28,895,042	32,773,392	Dec. 3,878,350	11¾
Total	$741,207,425	$726,819,480	Inc. $14,387,945	2

This gives as the amount per mile of road:

	1874-75.	1873-74.	Inc. or Dec.	P. c.
Capital stock	$54,014	$55,590	Dec.. $1,576	2 8
Funded debt	41,858	40,297	Inc .. 1,561	3.9
Floating debt	3,889	4,528	Dec.. 639	14.1
Total	$99,761	$100,415	Dec.. $654	6.5
Cost	84,333	82,692	Inc .. 1,641	2.0

The stock and debts for the last year were 18 per cent. greater than the cost, and about 62½ per cent. greater than the average for the United States ($62,725).

The reports of train mileage, passenger and tonnage mileage are vitiated for the reason that they are not for the same mileage reported under "characteristics of road." Each company reports its business for its entire system of roads, owned and leased, in and out of the State; but the mileage reported in the abstract is only that owned, branches being separated from main line, but leased lines not being included. So far as leased lines within the State are concerned, this is immaterial; the mileage is reported by the owner, and is included in the total; but with leased lines outside of the State it is different. Their traffic is included in the total of the abstract, but not their mileage, thus exaggerating the average traffic per mile. The Atlantic & Great Western, the Erie and the Lake Shore & Michigan Southern have a considerable leased mileage out of the State; and the total of all roads, so far as we can ascertain by a hasty examination, was reported about 708 miles for the year. We shall estimate, therefore, that the mileage for which "doings of the year in transportation" are reported amounts to 8,134 miles, instead of the 7,426 of "total length," which, however, seems to have been taken as the basis of some statements in the abstract. However, the figures there given do not in all cases agree with this mileage or with each other. The statement that the "aggregate movement of passenger trains is equivalent to passing over the road 2,636 times" would make the total length of road 7,493.78 miles; but the subsequent statement that the "aggregate movement of freight trains is equivalent to passing over the road 4,779 times" would make the length of road 7,425.98, or very nearly the length given in the abstract of "characteristics of road"—7,425.79. The aggregate movement of passenger trains is reported to be "equivalent to passing over entire single track 1,762 times," which, with the passenger-train mileage given, requires 11,210.39 miles of track; while the movement of freight trains "equivalent to passing over the entire single track 3,150 times" requires 11,266.27 miles of track. Under "characteristics of road" the mileage of track is stated as 11,264.75.

The work reported for two years, then, has been:

	1874-75.	1873-74.	Inc. or Dec.	P. c.
Pass'ger-train mileage	19,752,703	18,465,830	Inc. 1,286,873	7.0
Freight-train mileage	35,488,775	43,953,254	Dec. 8,464,479	19.2
Passengers carried	38,987,923	34,719,018	Inc. 4,268,305	12.3
Tons carried	32,408,547	33,555,595	Dec. 1,147,048	3.4
Passenger mileage	1,032,809,456	1,108,107,902	Inc. 24,701,554	2.2
Tonnage mileage	4,346,077,786	4,495,945,932	Dec.147,868,146	3.3

The traffic thus appears to have changed but little—a slight increase in passengers, and a slight decrease in freight. The considerable changes in train mileage are produced by a great change in the average train-load. This was:

	1874-75.	1873-74.	Inc. or Dec.	P. c.
No. of passengers	52.29	60.00	Dec.. 7.71	12.8
No. tons freight	122.42	102.29	Inc .. 20.13	19.7

The great increase in the average freight-train load is the con-

* These figures do not agree with those in the report for 1873-74, but are in all cases larger,—in the total $22,770,000 greater. The changes are probably corrections.

tinuation of progress in this direction begun some years ago, and quite general in most parts of the country where there is a heavy freight traffic. In 1872-73 the average load was but 98 tons.

The little table above measures the work of the roads, and dividing by the mileage we get the average traffic of the New York railroad system. We add 708 miles for the leased mileage outside of the State and thus obtain the following results for the later year:

The passenger train movement was equivalent to 3.33 trains each way daily over the entire system, and the freight train movement to 5.98 trains. The passenger movement was equivalent to 174 passengers, or three full car loads, and the freight movement to 732¼ tons, or 73 full car-loads, each way daily. Thus the entire traffic of the railroads of the most populous State in the Union, if uniformly distributed, could be carried by one small passenger train and two large freight trains daily over the entire system.

The earnings and expenses for the three years are reported as follows:

Earnings:	1874-75.	1873-74.	Inc. or Dec.	P. c.
Passenger	$24,743,856	$25,369,851	Dec.. $625,995	2.5
Freight	56,828,279	65,085,604	Dec.. 8,257,325	12.7
Other	7,550,286	7,495;619	Inc .. 54,667	0.7
Total	$89,122,421	$97,951,074	Dec..$8,828,652	9.0

We will not venture to estimate the mileage from which the earnings of 1873-74 were made; but a considerable length of leased roads out of the State were worked that year and not the next, and probably there was not much change in the mileage worked. The large decrease of 9 per cent. in total earnings, following one of 6½ per cent. the previous year, so that the decrease is 15 per cent. from the year next preceding the panic, is notable and lamentable enough without taking into account the increase of mileage. We hope to get more comfort from the expenses, which were:

Expenses:	1874-75.	1873-74.	Decrease.	P.c.
Maintenance of road	$16,808,734	$17,987,216	$1,178,482	6.6
Maintenance of machinery	11,168,626	12,209,769	1,041,143	8.5
Operating road	33,001,128	35,890,990	2.889,862	8.0
Total	$60,978,488	$66,087,975	$5,109,487	7.7
Net earnings	28,143,933	31,863,099	3,719,166	11.6

The decrease in earnings has thus been mostly made up by a decrease in expenses, which also is a continuation of progress in economy, the decrease in expenses having been 7.2 per cent. for the first year after the panic, and the decrease for the two years since that time is just about $10,000,000, or 14 per cent. Net earnings in the two years, during which there has been some increase in mileage, have fallen from $33,570,000 to $28,144,000; but this decrease of profits of 16 per cent. has been accompanied by such an increase in the purchasing power of money that, but for the fixed charges entailed by the large funded debts of the railroads, the change in income would not be formidable.

Meanwhile, however, the yearly interest charge has been growing. The payments for interest and dividends were:

	1874-75.	1873-74.	Increase.	P.c.
Interest	$12,814,005	$10,476,279	$1,837,726	17.5
Dividends	15,257,038	11,712,066	3,544,972	30.3

The great increase in dividends is due almost entirely to the fact that in changing from half-yearly to quarterly dividends the New York Central paid 10 per cent. instead of 8 per cent. within the year covered by the report, and the Lake Shore, which made no dividend on common stock in the earlier year, divided 3¼ per cent. in the later. The New York Central was the only company with its road chiefly in the State which paid any considerable amount in dividends. The dividends made were sufficient for an average payment of 3.8 per cent. on the total stock, and the interest to a trifle less than 4 per cent., though the average rate due cannot be less than 6½ or 7. The difference is due, doubtless, to the defaults of many companies. The payment of 7 per cent. on the total funded debt would exhaust all of the net earnings but $6,500,000, which would pay but 1.6 per cent. on the stock.

The deductions and comparisons made above are, of course, based upon the statements made in the report, and are no more trustworthy than they. For the earlier year, we fear that the errors are great; but there are such evidences in the later one of efforts to avoid previous errors that we put more confidence in it and are led to hope that we at last have the beginning of a valuable record of the statistics of the New York railroads.

Experiments with the "Miltimore" Car-Axle.

The following accounts of experiments have recently been published in a pamphlet issued by the "Miltimore Car-Axle Company." This axle has, as most of our readers know, loose wheels which can turn independently of each other. It is said in the pamphlet that "the following is the statement, as approved by Mr. Henry Waterman, expert of the Eastern Railroad Association":

Arlington curve—Miltimore truck—3° [=1,910 ft. radius]; grade, 32 ft. to mile. Gross average draft of train, 2,769 2-10 lbs.=25 27-100 lbs. per ton; less 12 12-100 lbs. per ton due to grade=13 15-100 lbs. per ton due to friction.

Ordinary trucks—(same curve and grade). Gross average draft of train, 3,050 lbs.=29 33-100 lbs. per ton; less 12 12-100 lbs. per ton due to grade=17 21-100 lbs. per ton due to friction.

Dorset curve—Miltimore trucks—4° [=1,433 ft. radius]; grade, 41 ft. to mile. Gross average draft of train, 3,200 lbs.=29 20-100 lbs. per ton; less 15 53-100 lbs. per ton due to grade=13 67-100 lbs. per ton due to friction.

Ordinary trucks—(same curve and grade). Gross average draft of train, 4,520 lbs.=42 08-100 lbs. per ton; less 15 53-100 lbs. per ton due to grade=26 55-100 lbs. per ton due to friction.

Recapitulation:

Arlington—ordinary trucks.....17.21 lbs. per ton.
" —Miltimore trucks.....13.15 " "
Balance in favor of Miltimore trucks..... 4.06 lbs. per ton.
Or a saving in power required of 23 6-10 per cent.

Dorset—ordinary trucks.....26.55 lbs. per ton.
" —Miltimore trucks.....13.67 " "
Balance in favor of Miltimore trucks.....12.88 lbs. per ton.
Or a saving in power required of 48¼ per cent.

Weight of Miltimore train—one baggage and four passenger cars—219,185 lbs.=109 592-1,000 [tons] (of 2,000 lbs.)

Weight of ordinary train—one baggage and four passenger cars—214,825 lbs.=107 415-1,000 tons (of 2,000 lbs.)

Formula used to ascertain the number of pounds per ton due to grade:

Arlington	5,280	32	2,000	12.12
Dorset	5,280	41	2,000	15.53

Saving of Fuel.—Superintendent White estimated that during the above described test of the Vermont Central Railroad, a saving of one-half cord of wood was made for each thirty miles, by the use of these patent axles.

Report of a test made on the West End Passenger Railroad, Philadelphia, by Mr. Henry Waterman, railway expert, showing 67 per cent. of friction in favor of the Miltimore patent axle, with independent wheels.

"HUDSON, N. Y., July 16, 1876.

"*S. M. Whipple, Esq., Agent Eastern Railroad Association:*

"DEAR SIR:—At the request of the gentlemen interested in the Miltimore (loose) wheel and axle, I made a trial with a view to ascertain the comparative friction between a railroad car equipped with their loose wheel and one with the ordinary tight wheel.

"The trial was made on the 14th inst., upon the narrow (36 inch) gauge railway track within the grounds of the Centennial Exhibition, at Philadelphia. The portion of the line selected was that in the rear of the Agricultural Hall, running southerly, and presented a large proportion of curvature of small radius, as for instance, starting upon a radius of 300 feet, curving to the right a distance of 450 feet—a straight line of 40 feet, then curving to the left, a radius of 332 feet, a distance of 370 feet—a straight line of 100 feet—a curve to the right of 282 feet radius, a distance of 450 feet—a straight line of 50 feet—a curve to the right of 279 feet radius, a straight line of 50 feet—a curve to the right of 347 feet. From the highest point of starting to the lowest point in the line, the average grade was 52.5 feet per mile, from this point the grade ascended at an average grade of 16.4 feet per mile.

"The survey was made by gentlemen connected with the engineer corps of the Pennsylvania Railroad Company. The cars were of the eight-wheel kind. The distance between the axles of the tight-wheel kind were 4 feet, of the loose wheels, 5 feet 6 inches. Both cars were examined and thoroughly oiled before trial. The rigid-wheel car ran a distance of 1,498 feet, when its momentum was exhausted, stopping at the lowest point in the line, vertical descent 14.8 feet. The loose wheel car (Miltimore) ran a distance of 1,850 feet, the last 350 feet upon an ascending grade of 16.4 feet per mile, the vertical descent being 13.8 feet.

"The following is the summary of the trial:

SUMMARY.

	Rigid wheel.	Loose wheel.
Whole distance run	1,498 ft.	1,850 ft.
Vertical descent	14.9 ft.	13.8 ft.
Average grade between starting and stopping points per mile	52 5 ft.	39.3 ft.
Friction on horizontal pull per ton	19.97 lbs.	14.98 lbs.
Friction due to curvature after deducting 7.5 for that of straight line	12.47 lbs.	7.48 lbs.

"Although I had my dynametric instrument present, I advised this mode of trial; as under all circumstances the most reliable and simple, and I think the result may be taken as a fair representation of the friction that will be developed when the conditions are as described.

"Very respectfully yours,
"HENRY WATERMAN."

It is not apparent from the above report why the difference in the resistance between tight and loose wheels on a curve of 1,433 ft. radius should be more than three times that in a curve of 1,910 ft. radius, both being on a 4 ft. 8½ in. gauge road, nor why on curves averaging about 300 ft. radius on a 3 ft. gauge road the difference should be only 4.99 lbs. per ton, while on a curve of wide gauge, with a radius nearly five times as long, the difference was 12.88 lbs.

To repeat what was said in last week's *Railroad Gazette* in an article on narrow gauge, the difference in the length of the inner and outer rails of a complete circle of a curve of any radius is equal to the circumference of a circle whose radius is equal to the gauge. Now, making the same calculation as that described in the article referred to, but taking the resistance to sliding at one-fourth instead of one-fifth, we find that the difference indicated by such calculation in the resistance due to the wheels being loose in the one case and tight in the other on the curves and gauges named would be as follows:

Gauge.	Radius of curve.	Calculated resistance due to sliding of wh'ls on curve.	Difference in resistance of light and loose wheels as given by the above experiments.
4 ft. 8½ in.	1,910 ft.	0.616 lbs.	4.06 lbs.
" "	1,433 "	0.821 "	12.88 "
3 ft.	300 "	2.5 "	4.99 "

By comparing the calculated resistance due to the sliding of the wheels with the difference in the resistance between fast and loose wheels as indicated by the experiments, it will be evident by the immense disparity between the two that either the calculation is entirely wrong or the experiments totally unreliable. Or, if we compare the results of the experiments with each other, it will be seen that there is no agreement between them. The experiments indicate that the resistance on a curve of 300 ft. radius on a three-feet gauge is very little more than on one of 1,910 ft. radius on a 4 ft. 8½ in. gauge, which doubtless will be quoted by some of the narrow-gauge propagandists as a proof of the advantage of their system, but in doing this they will also incur the awkward obligation of explaining why the difference in the resistance on a curve of 1,433 feet radius is more than three times that on one of 1,910 ft.

There is, however, a very serious omission in the experiments published by the Miltimore Car-Axle Company; they do not give the difference in the resistance on a straight line. We have good reason for believing that experiments *were made* to determine this: why are the results not published? If the resistance of loose wheels on a straight line is less than with wheels which are fast, the publication of a report of experiments establishing that fact would have the effect of correcting the error, into which we in common with many experienced railroad engineers have fallen, of believing that the resistance of loose wheels on a straight line is considerably greater than that of wheels fast on the axles.

The Grain Movement for Seventeen Weeks.

The shipments of grain of all kinds from the eight principal Northwestern markets for each week since April 22 have been, in bushels, by lake and by rail:

Week ending—	By lake.	By rail.	Total.	Per ct. by rail.
April 29	1,634,541	2,072,946	3,707,487	56
May 8	2,445,191	2,292,633	4,737,824	48½
" 13	1,538,526	2,302,940	3,841,466	60
" 20	1,602,170	2,016,304	3,618,474	55¾
" 27	1,747,408	1,920,456	3,567,864	51
June 3	2,412,162	1,797,922	4,210,084	42¾
" 10	2,894,915	2,147,670	5,042,585	42½
" 17	2,921,405	2,391,811	5,313,216	45
" 24	2,728,706	2,198,054	4,926,760	44¾
July 1	1,821,155	1,784,548	3,605,703	49½
" 8	1,765,010	1,205,184	2,970,194	40¾
" 15	1,648,508	1,228,678	2,877,186	42¾
" 22	2,269,336	1,032,825	3,302,161	31¾
" 29	1,466,502	1,038,208	2,504,710	41½
Aug. 5	2,055,243	1,283,268	3,338,511	38¾
" 12	1,744,059	1,300,720	3,044,779	43¾
" 19	2,150,292	1,614,256	3,764,548	43¾
Total for 17 weeks	34,845,129	29,528,423	64,373,552	45¾

The movement is becoming active again, apparently: They have been larger but six out of the seventeen weeks, and the last week's are just about an average for the whole period, but the largest of the past seven weeks. The increase since last week has grown in good proportions to cars and vessels. The water shipments have been exceeded six times, the rail shipments ten times since the opening of navigation. There has been time since harvest for new wheat to come forward from several districts, but the wheat movement is very light, not half as great as last year, and nearly half the shipments are of corn.

For the same seventeen weeks receipts at Atlantic ports were:

	Corn.	Per cent of total.	All grains.	Per cent. of total.
New York	9,797,680	28.8	30,237,950	45.1
Boston	3,646,573	10.7	4,918,672	7.4
Portland	315,700	0.9	647,870	0.9
Montreal	1,678,017	4.9	6,953,567	10.4
Philadelphia	9,244,200	27.1	12,741,150	19.0
Baltimore	7,940,700	23.3	9,488,685	14.2
New Orleans	1,452,106	4.3	1,957,274	3.0
Total	34,074,976	100.0	66,945,168	100.0

New York and Baltimore, in comparison with their places last week, lose position as corn receivers, while Boston, Montreal and Philadelphia gain. In grains of all kinds, New York loses, and all other ports except Portland gain. The proportions of the total receipts of the last week at each leading port were, of corn: Philadelphia, 28⅛ per cent.; New York, 25 per cent.; Baltimore, 18⅝; Boston, 12⅝; Montreal, 1.1: of all grains: New York, 26⅕ per cent.; Philadelphia, 25½; Baltimore, 17; Montreal, 16¾; Boston, 9⅛; New Orleans, 4 per cent.

New York's grain receipts have been smaller but once since navigation opened; they are not one-half of its average for that period. Its corn receipts are but about one-fifth less than its average. Philadelphia receipts of all grains were nearly up to its average, Baltimore's, about an eighth less than its average. In corn receipts, Philadelphia, which led for some time, is again close to New York and considerably ahead of Baltimore. Should there be an active wheat movement next month, New York probably will improve its position, as usually comparatively little of that grain goes to Philadelphia and Baltimore. The latter places, however, seem to have demonstrated their ability, in the face of unprecedentedly low lake and canal rates, to secure half of the corn business.

The Coal Auction and the Coal Roads.

The great coal auction last Tuesday, at which half a million tons of coal brought prices about $2.10 per ton less—nearly 40 per cent.—than those which had been fixed upon by the late combination, has attracted a great deal of attention, as likely to indicate the normal prices of coal at this time, when not supported by a combination of the producers and carriers. But it is hardly probable that this sale has set prices for the season. It was not made under such circumstances as to indicate the normal demand for coal, for the sale was made not in a market requiring coal, and so purchasing to supply its necessities, but in one rather overstocked than understocked with coal, and therefore not compelled to purchase. It was thus substantially a forced sale on a full market, and consequently prices were slaughtered. Unless all who produce and carry coal have joined in falsifying the facts, the prices received last Tuesday do not nearly cover the actual cost of mining and transporting; and this being the case we cannot expect that there will be any further production at these prices, unless there should be a competitive "coal war," of which there are no signs, none of the companies having any money to throw away. It is hinted that the sale was rather an accident than the result of any deliberate design, and that the companies repented of their determination after the announcement and before the sale, seeing that the circumstances were such as to make disastrous prices probable. For the prices obtained certainly are disastrous. They would reduce the income of producers or producers and carriers of anthracite at the rate of about $40,000,000 a year—that is, would make the business wholly unprofitable. Last year's report showed that the Philadelphia & Reading Company made a profit of about 75 cents a ton on the coal which it carried to Philadelphia. Whether this profit was too large or too small, it is plain that a reduction of two dollars a ton in price cannot possibly be borne by the carrier. But the operators at the mines complain that the margin of profit left to them will not bear a reduction of half this amount, whence it is natural to conclude that producers will refuse to market coal as long as the prices offered are no greater than those obtained at the auction. In all probability coal will be cheaper than it has been, however.

Up to the time of the sale, the production of 1875 (eight months) had been less than ten million tons—less than half

last year's production, but probably enough more than half of this year's. If all this had been sold a considerable reduction for two or three months would not be very formidable; but the great companies have large stocks on hand, which of course must suffer from the fall in prices.

It would, doubtless, be an advantage to the country, and especially to iron industries, if the reduction of two dollars a ton were permanent, *if it could be afforded.* But it is easy to exaggerate the advantage. Iron masters say that a large business cannot be created in the present condition of things by any amount of reduction, and with the present capacity of works, prices would be sure to fall nearly or quite enough to balance the economy by cheaper coal.

Of course not the whole amount of the reduction in price hereafter, whatever it may be, will fall on the carriers; but the great coal carriers being also the chief producers, they will suffer much more than from a reduction in freight charges, which, indeed, may not be made at all. If the auction prices were to prevail, the ruin of all of them would be only a question of time; but perhaps they will do better with a more moderate reduction of "combination prices" than if they had been maintained; though it is not a time when any great increase in coal consumption can be effected.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Columbia & Port Deposit.—Extended from Safe Harbor, Pa., southeast to Phyte's Eddy, 13 miles.

San Luis Obispo & Santa Maria Valley.—Completed from Avila, Cal., to San Luis Obispo, 9 miles. It is of 3 ft. gauge.

This is a total of 22 miles of new railroad, making 1,253 miles completed in the United States in 1876, against 614 miles reported for the same period in 1875, 962 in 1874, 2,252 in 1873, and 3,962 in 1872.

A FUSION OF THE GRAND TRUNK AND THE GREAT WESTERN is much talked of in England, where the impression seems to prevail that the chief competition from which these roads suffer is that with each other, the fact being that their competition rarely if ever determines the rates for through traffic, while there is not a vast deal of local traffic for which they compete. It is true that both companies have a line between Buffalo and Detroit; but these form but an interior link in a through line. The through traffic does not originate on this link but is delivered to it at either extremity by other companies, which with their competitors mainly determine the rates. The Grand Trunk, however, has a different line which competes with all through roads east of Detroit. It might agree upon a division of the business between Detroit and the Niagara River, but it would remain for its interest to cultivate a through business by way of Toronto, Montreal and New England which it could not very well divide with the Great Western, because the Great Western has no similar traffic which it can command. There is apparently no present prospect of a consolidation but only of a cessation of competition for traffic at common points. This is doubtless advisable and will be advantageous; but it will not prevent ruinously low through rates such as now prevail. Other companies have more to do in fixing these rates, and usually the Canadian roads can only take what others do, except that the Grand Trunk for New England business usually takes less than others do.

JULY EARNINGS are reported in our table for 28 railroads with 14,791 miles of railroad, which is about 20 per cent. of the total in operation in the country. Of these, 18 show an increase this year as compared with last, but the decreases are so much larger in amount that there remains an aggregate decrease of $392,558, or 5.4 per cent.

The mileage meanwhile has increased a little, and there is a decrease in earnings per mile from $501 to $464, or 7.4 per cent. The change would not be noticeable if the roads had been doing a good business last year. The changes for several of the roads are very great, five have an increase and five a decrease of 20 per cent. or more. Of those most affected by the current low through rates between the East and the West, the Atlantic & Great Western, the Canada Southern, the Michigan Central and the Philadelphia & Erie report. Of these the Canada Southern, which had very little to do last year, shows an increase, the others decrease.

For the seven months ending with July, 26 roads report, with 17 per cent. of the mileage of the country, showing an increase of 5 per cent. in average earnings per mile, only six of the number showing any decrease.

MONTREAL threatens to absorb the long-established lumber export traffic of Quebec. This is an important business—doubtless the most important export business of Quebec, whose advantages lie chiefly in its position at the head of tide-water. Quebec partizans claim that the loss is chiefly due to artificially high dock charges there.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Michigan Central.—Mr. John D. Foster has been appointed Western Passenger Agent, with headquarters in Chicago.

Intercolonial.—Mr. James McAllister has been appointed Treasurer, in place of Alfred Brush, who lately disappeared, leaving a considerable deficiency in his accounts.

Wyandotte, Kansas City & Northwestern.—Col. Vaughan, Chief Engineer, has been appointed Superintendent, in place of F. C. Eames, resigned.

Northwestern Ohio.—The following directors were recently chosen for this new company: J. N. McCullough, T. D. Messler, Frank James, George W. Layng, R. F. Smith, D. L. Zink, J. F. Brooks. The board elected George W. Layng President, and Frank James Secretary and Treasurer. The company is successor to the Toledo, Tiffin & Eastern, whose road was recently sold under foreclosure.

RAILROAD EARNINGS IN JULY.

Name of Road.	Mileage. 1876.	1875.	Inc.	Dec.	Per c.	Earnings. 1876.	1875.	Increase.	Decrease.	Per c.	Earnings per Mile. 1876.	1875.
Atchison, Topeka & Santa Fe	711	508	203	.....	40.2	$194,194	$112,705	$81,489	.....	72.3	$273	$222
Atlantic & Pacific	328	328	.....	.....	.....	88,600	84,400	4,200	.....	5.0	270	257
Atlantic & Great Western	502	502	.....	.....	.....	318,811	408,519	.....	$89,708	22 0	635	814
Burlington, Cedar Rapids & Northern	401	401	.....	.....	.....	73,248	132,903	.....	59,655	44.9	183	331
Cairo & St. Louis	146	146	.....	.....	.....	22,595	19,410	3,185	.....	16.4	155	133
Canada Southern	452	452	.....	.....	.....	108,787	104,890	3,897	.....	3.7	241	232
Central Pacific	1,315	1,315	.....	.....	.....	1,507,000	1,536,225	.....	29,225	1.9	1,146	1,168
Chicago & Alton	650	650	.....	.....	.....	397,269	387,445	9,824	.....	2.5	611	596
Chicago, Milwaukee & St. Paul	1,400	1,399	1	.....	.....	685,753	842,395	.....	156,642	18.6	490	602
Denver & Rio Grande	206	120	86	.....	71.7	39,120	29,663	9,457	.....	31.8	190	247
Hannibal & St. Joseph	296	296	.....	.....	.....	138,087	113,031	25,056	.....	22.2	467	382
Illinois Central	1,109	1,109	.....	.....	.....	482,003	715,899	.....	233,896	32.5	435	646
Indianapolis, Bloomington & Western	344	344	.....	.....	.....	88,507	87,445	1,062	.....	1.2	257	255
International & Great Northern	459	459	.....	.....	.....	72,870	70,986	1,884	.....	2.7	159	155
Kansas Pacific	784	761	23	.....	3.0	234,042	292,462	.....	58,420	20.0	297	384
Louisville & Nashville	738	738	.....	.....	.....	357,539	303,455	54,084	.....	17.8	484	411
Michigan Central	804	804	.....	.....	.....	430,627	467,159	.....	36,532	7 8	536	581
Missouri, Kansas & Texas	786	786	.....	.....	.....	224,308	211,735	12,573	.....	6.5	285	269
Nashville, Chattanooga & St. Louis	341	341	.....	.....	.....	127,396	116,054	11,342	.....	9.8	372	338
Ohio & Mississippi	615	615	.....	.....	.....	247,646	239,156	8,490	.....	3.6	403	389
Philadelphia & Erie	288	288	.....	.....	.....	256,386	322,837	.....	66,551	20.6	890	1,121
St. Louis, Alton & Terre Haute—Belleville Line	71	71	.....	.....	.....	29,338	35,753	.....	6,215	17.3	416	532
St. Louis, Iron Mountain & Southern	685	685	.....	.....	.....	253,500	226,241	27,259	.....	12.1	370	330
St. Louis, Kansas City & Northern	504	504	.....	.....	.....	216,917	153,497	63,420	.....	41.5	430	305
St. Louis & Southeastern	349	349	.....	.....	.....	89,935	67,145	22,790	.....	34.0	258	192
St. Paul & Sioux City	122	122	.....	.....	.....	54,959	55,270	.....	311	0.5	450	453
Sioux City & St. Paul	148	148	.....	.....	.....	30,031	28,795	1,235	.....	4.3	203	195
Toledo, Peoria & Warsaw	237	237	.....	.....	.....	92,666	89,317	3,349	.....	3 8	391	377
Totals	14,791	14,478	313	.....	.....	$6,882,234	$7,254,792	$344,597	$737,155	.....	$464	$501
Total increase or decrease	.....	.....	313	.....	2.2	.....	.....	.....	392,558	5.4	.....	.....

RAILROAD EARNINGS, SEVEN MONTHS ENDING JULY 31.

Name of Road.	Mileage. 1876.	1875.	In.	Dec	Per c.	Earnings. 1876.	1875.	Increase.	Decrease	P.c.	Earnings per mile. 1876.	1875.	Inc.	Dec.	P.c.
Atchison, Topeka & Santa Fe	656	508	148	....	29.1	$1,239,996	$688,382	$551,614	.....	80.1	$1,890	$1,355	$535	.....	39.5
Atlantic & Pacific	328	328	....	....	.....	699,898	647,151	52,747	.....	8.2	2,137	1,973	164	.....	8.2
Burlington, Cedar Rap. & North.	401	401	....	....	.....	662,483	705,883	.....	$43,400	6.1	1,652	1,760	.....	$108	6.1
Cairo & St. Louis	146	133	13	....	9.8	146,663	142,929	3,734	.....	2.6	1,005	1,091	.....	86	7.9
Canada Southern	452	452	....	....	.....	935,794	622,846	312,948	.....	50.2	2,070	1,378	692	.....	50.2
Central Pacific	1,315	1,296	19	....	1.5	9,446,408	.....	38,408	0.4	7,154	7,289	.....	135	1.9	
Chicago & Alton	650	650	....	....	.....	2,643,970	2,500,411	143,559	.....	5.7	4,068	3,847	221	.....	5.7
Chicago, Milwaukee & St. Paul	1,400	1,399	1	....	.....	4,645,938	4,234,836	411,102	.....	9.7	3,319	3,027	292	.....	9.7
Denver & Rio Grande	145	120	25	....	20.8	243,972	202,652	41,320	.....	20.4	1,683	1,689	.....	6	0.4
Hannibal & St Joseph	296	296	....	....	.....	1,042,789	858,512	184,277	.....	21.5	3,523	2,900	623	.....	21.5
Illinois Central	1,109	1,109	....	....	.....	4,030,604	4,201,975	.....	171,371	4.1	3,634	3,789	.....	155	4.1
Indianapolis, Bloom. & West'n	344	344	....	....	.....	858,038	684,932	173,106	.....	25.3	2,494	1,991	503	.....	25.3
International & Gt. Northern	459	459	....	....	.....	640,817	661,752	.....	20,935	3.2	1,396	1,442	.....	46	3.2
Kansas Pacific	774	761	13	....	1.7	1,598,079	1,785,126	.....	187,047	10 5	2,065	2,348	.....	281	12.0
Michigan Central	804	804	....	....	.....	3,896,111	3,662,197	233,914	.....	6.4	4,846	4,555	291	.....	6.4
Missouri, Kansas & Texas	786	786	....	....	.....	1,642,146	1,440,750	201,396	.....	14.0	2,089	1,833	256	.....	14.0
Nashville, Chattanooga & St. L.	341	341	....	....	.....	1,004,092	879,862	124,170	.....	14.1	2,944	2,580	364	.....	14.1
Ohio & Mississippi	615	552	63	....	11.4	2,095,415	1,828,220	267,195	.....	14.6	3,407	3,312	95	.....	2.9
Philadelphia & Erie	288	288	....	....	.....	1,822,007	1,785,208	36,799	.....	2.1	6,326	6,199	127	.....	2.1
St. Louis, Alton & Terre Haute, Belleville Line	71	71	....	....	.....	263,610	313,839	.....	50,229	16.0	3,713	4,420	.....	707	16.0
St. Louis, Iron Mt. & Southern	685	688	....	....	.....	1,972,886	1,869,190	103,696	.....	5.6	2,880	2,720	161	.....	5.6
St. Louis, Kansas City & North'n	504	504	....	....	.....	1,717,202	1,388,839	328,363	.....	23.7	3,407	2,756	651	.....	23.7
St. Louis & Southeastern	349	349	....	....	.....	697,102	646,410	50,692	.....	9.3	1,711	1,566	145	.....	9.3
St. Paul & Sioux City	122	122	....	....	.....	316,497	253,481	63,416	.....	25.0	2,598	2,078	520	.....	25.0
Sioux City & St. Paul	148	148	....	....	.....	192,344	132,954	59,390	.....	44.7	1,300	898	402	.....	44.7
Toledo, Peoria & Warsaw	237	237	....	....	.....	786,031	518,732	267,299	.....	51.5	3,317	2,189	1,128	.....	51.5
Totals	13,425	13,143	282	....	.....	45,102,824	42,008,477	$3,610,737	$511,390	.....	$3,360	$3,196	$164	.....	5.1
Total increase	.....	.....	282	....	2.1	.....	.....	3,099,347	.....	7.4	.....	.....	.....	.....	.....

PERSONAL.

—Mr. Williams, General Accountant of the Illinois Midland, committed suicide at his residence in Paris, Ill., Aug. 22. He came over from England last year to take the position, and had recently suffered much from fever and ague, which, with the involved condition of the company's affairs, had thrown him into a very depressed state of mind.

—Mr. John H. Kilbourne, a heavy contractor, who built a considerable section of the Grand Rapids & Indiana road, and now holds a contract on the Chicago & Lake Huron, has been nominated for Congress by the Democrats of the Ninth Michigan District.

—Mr. W. P. Ijams has resigned his position as Treasurer of the Logansport, Crawfordsville & Southwestern road.

—Mr. Thomas Krajewski, a mechanical engineer of marked ability, educated at the Zurich Polytechnicum, formerly in the service of one of the great locomotive works at Paterson, and more recently in the office of the *Railroad Gazette*, has been appointed purchasing agent of an association of Russian farmers who are introducing American agricultural machinery. Mr. Krajewski was bred a farmer, and this fact, coupled with his knowledge of machine construction, gives him unusual qualifications for his new position.

—Mr. George H. Griggs has resigned his position as General Superintendent of the Keokuk & Des Moines Railroad, and will, it is said, accept a position on the Connecticut Valley road.

TRAFFIC AND EARNINGS.

Chicago & Colorado Freight Line.

The Chicago *Inter-Ocean* says that the Chicago & Northwestern and the Union Pacific companies have agreed to carry between Chicago and points in Nebraska, Wyoming, Colorado and New Mexico. The other roads between Chicago and Council Bluffs have long done a Colorado business through their connections with the Kansas Pacific. A schedule of rates has been adopted, which is as follows, per 100 lbs.:

	First class.	Second class.	Third class.	Fourth class.	Special class.	Class A, per car.	Class B, per car	Lumber, per car.
Chicago to Council Bluffs, Ia.	$0 85	$0 70	$0 45	$0 30	$0 25	$75 00	$60 00	$62 50
Omaha, Neb.	0 90	0 85	0 60	0 35	0 30	85 00	70 00	72 50
Fremont, Neb.	1 13	0 96	0 68	0 50	0 45	110 00	90 00	90 50
Cheyenne, Wyoming	2 75	2 30	1 75	1 55	1 45	225 00	210 00	187 50
Denver, Col.	3 25	2 70	2 20	1 70	1 55	275 00	210 00	198 50
Golden, Col.	3 43	2 86	2 54	1 82	1 66	295 00	224 30	198 50
Pueblo, Col.	3 25	2 70	2 20	1 70	1 55	275 00	210 00	186 50
El Moro, Col.	3 62	2 93	2 39	1 85	1 69	298 00	227 00	202 50

Under lumber is included manufactured lumber, such as sashes, blinds, doors, etc.

Ocean Freights.

Changes were not considerable during the week ending Tuesday, when 9d. per bushel by rail was given as the rate for grain by sail from New York to Cork for orders, 7¼d. to London by steam; 50s. per ton for cheese to Liverpool, 35s. for bacon, 11-32d. per pound for cotton.

The San Francisco *Bulletin* of Aug. 17 says: "There are already more vessels under engagement than can be loaded up to Oct. 1, and a large supply of disengaged tonnage in port and overdue. Freights to England are nominal at 50s. to 55s."

Grain Movement.

Receipts and shipments for the week ending Aug. 19, are reported as follows:

	1876.	1875.	Inc. or Dec.	P.c.
Lake ports' receipts	3,926,289	3,684,639	Inc..	241,650	5.2
Lake ports' shipments	3,764,548	2,658,444	Inc..	1,106,104	41.6
Atlantic ports' receipts	2,913,160	3,003,929	Dec..	90,769	3.0

Of the shipments from lake ports 42% per cent. was by rail this year, against 26¾ in 1875 and 15¾ in 1874.

Chicago receipts and shipments for the week ending Aug. 26 were:

	1876.	1875.	Increase.	P. c.
Receipts	2,419,892	2,053,287	366,605	18.0
Shipments	2,168,739	2,142,952	25,787	1.2

Compared with the previous week there is also an increase. For six weeks past the course of the grain movement at this port has been:

Week ending—	Receipts.	Shipments.
July 22	1,653,116	1,581,020
" 29	1,535,151	1,617,084
Aug. 5	1,348,329	1,979,607
" 12	1,842,528	1,431,649
" 19	2,109,511	1,919,125
" 26	2,419,892	2,168,739

Considerable progress was made in August, as was to be expected, but the movement has been unusually light in wheat and heavy in corn. Last week's receipts were nearly five-sixths corn.

The Winter Port of Canada.

The Committee of the Halifax (N. S.) Chamber of Commerce has prepared a long report setting forth the advantages which Halifax presents, since the completion of the Intercolonial Railway, over Portland or Boston as a winter port for Canadian traffic and travel. The claims made are the shorter sea voyage, excellent wharf and harbor accommodations, light harbor charges and abundant and cheap coal supply. The advantages of Halifax as a port for trade with the West Indies are also pointed out, and the possibility of a great increase of the business between Canada and the West Indies is spoken of. A number of sailing vessels are already employed in this trade.

Coal Movement.

Coal tonnages are reported as follows for the week ending Aug. 19:

	1876.	1875.	Inc. or Dec.	P.c.
Anthracite	326,390	542,298	Dec..	215,908	39.8
Semi-bituminous, Broad Top	4,173	.....	.....	....
" " Clearfield	25,101	18,234	Inc..	6,867	37.7
" " Cumberland	41,530	51,573	Dec..	10,043	19.5
Bituminous, Barclay	6,584	7,324	Dec..	740	10.1
" Allegheny Region	4,400	39,474	Dec..	11,549	29.2
" Pittsburgh Region	23,525			

The great sale of 500,000 tons of coal by four of the companies lately in the combination took place in New York as adver-

tised, Aug. 29. Of the 500,000 tons the Delaware & Hudson Canal Company contributed 110,000; the Delaware, Lackawanna & Western 110,000; the Philadelphia & Reading 200,000, and the Pennsylvania Coal Company 80,000. The sales were made for future delivery in regular monthly installments at the tide-water termini of the respective companies subject, as to time of delivery, to all contingencies of storms, floods, accidents, miners' strikes, etc. The prices obtained, as compared with those established by the late combination for August, were as follows for the several sizes into which anthracite coal is usually assorted:

	Del. & Hud. C. Co.'s lot.		D., L. & W. lot.		Phil. & Read'g lot.		Pa. Coal Co.'s lot.		Com. pr's.
Lump	.....		.....		.....		$2.50	to	.....
Steam-boat	$2.75	to $3.00	$2.70	to $2.85	$2.00	to $2.25	2.72½	to	$4.55
Grate or broken	3.20	to 3.50	2.85	to 2.85	2.45	to 2.85	2.67½	to 2.70	4.70
Egg	3.12½	to 3.25	2.75	to 2.80	2.07½	to 2.62½	2.85	to 2.90	5.00
Stove	3.80	to 3.90	3.55	to 3.65	2.62½	to 3.25	3.60	to 3.80	5.80
Chestnut	.....		2.70	to 2.75	1.75	to 2.20	2.05	to 3.43½	4.65

It will be seen that the fall in prices was very large. A great number of people were present at the sale, not all buyers, however. The principal buyers were large coal dealers of New York and Philadelphia. It is said that many operators will prefer a suspension of production to such low prices. The companies must have lost 75 cents a ton on every ton sold—the actual cost of production and transportation exceeding the prices obtained by that amount.

The Philadelphia & Reading Coal & Iron Company has given notice that all existing contracts for the delivery of coal may be annulled at the option of the purchaser. Prices for delivery in September are to be fixed by circular, which was to be issued Aug. 30.

Railroad Earnings.

Earnings for various periods are reported as follows:

Seven months ending July 31:

	1876.	1875.	Inc. or Dec.	P. c.
Philadelphia & Erie....	$1,822,007	$1,786,208	Inc .. $36,799	2.1
Expenses.....	1,335,487	1,273,072	Inc .. 62,415	4.9
Net earnings.....	$486 520	$512,136	Dec .. $25,616	5.0
Per cent. of expenses.	73.30	71.31	Inc .. 1.99	2.8
Month of July:				
Nashville, Chattanooga & St. Louis.....	$127,396	$116,054	Inc .. $11,342	9.8
Expenses.....	82,883	71,233	Inc .. 11,650	16.4
Net earnings.....	$44,513	$44,821	Dec.. $308	0.7
Per cent. of expenses	65.06	61.38	Inc .. 3.68	6.0
Philadelphia & Erie...	256,286	322,837	Dec .. 66,551	20.6
Expenses.....	198,061	202,423	Dec .. 4,362	2.2
Net earnings..	$58,225	$120,414	Dec.. $62,189	51.7
Per cent. of expenses	77.28	62.71	Inc .. 14.57	23.2
Second week in August:				
Denver & Rio Grande, Main Line	$8,224	$8,546	Dec.. $322	3.8
Denver & Rio Grande, Trinidad Extension..	2,358	.....	.....	....
Third week in August:				
Atchison, Topeka & Santa Fe.....	$57,323	$42,079	Inc .. $15,244	36.2
Chicago, Milwaukee & St. Paul.....	115,000	140,479	Dec .. 25,479	18.1
Ohio & Mississippi....	77,673	70,202	Inc .. 7,471	10.6
St. Louis, Kansas City & Northern.....	61,195	74,607	Dec.. 13,412	18.0
Week ending Aug. 11:				
Great Western, of Canada.....	£13,110	£14,832	Dec.. £1,722	11.6
Week ending Aug. 12:				
Grand Trunk	£14,700	£36,600	Dec.. £1,900	5.2

Delaware Peach Traffic.

The total movement of peaches passing Wilmington, Del., on the Delaware Railroad up to and including Aug. 23, was 1,515 car-loads. The traffic is lighter than last year and is already beginning to fall off pretty fast.

THE SCRAP HEAP.

Compliments to an Engineer.

A newspaper published in a town where a question of location was decided contrary to the desire of the citizens, speaks as follows of the engineer in charge. We infer from its language that it is somewhat unkindly disposed towards the engineer; at least it leaves that impression with us. The words are:

"If —— had his merits, his neck would long since have been strung up from some tree on the swamp. He did not behave like a gentleman, but acted like a contrary hedgehog or mule. All along the lines of railroad on which he served as Chief Engineer, he behaved as roughly as possible, and seemed to take delight in making all with whom he came in contact miserable. May the devil take him to home, and roast him in the hottest hell."

Train Wrecking.

We gave last week an account of an attempt to wreck an express train on the New York Central & Hudson River road on a high bank near Fairport, N. Y., by the removal of a rail from the track. The train was saved by a man named Adams, who represented that he was a drover, and who called a farmer near by, who succeeded in stopping the train. This Adams told a story to the effect that while walking along the track towards the depot he had seen a gang of tramps at work removing the rail, had heard them refer to the coming accident, but being alone, was unable to stop them. The company put the matter into the hands of detectives, who soon arrived at the conclusion that Adams himself had removed the rail. He was arrested and subsequently confessed that he had done so, and also that he had caused the accidents on the Lake Shore road at Lakeview, Aug. 11, and at Northeast, Aug. 16, in the former place by changing a switch, and in the latter by removing a rail. He claimed that he had not intended to cause a wreck in either case, but expected to flag the trains in time and to get a place on the road as a reward for saving the train. The man, whose name is George E. Adams, is only 23 years old, and has been for a time a brakeman on the Lake Shore road, which made him familiar with railroading to a certain extent. He had, however, borne a very poor character and had served a short term in the penitentiary for stealing.

OLD AND NEW ROADS.

Miami Valley.

A contract for the construction of this road from Cincinnati northeast to Waynesville, O., 41 miles, has been concluded. Work is to be begun early in September and to go on as fast as possible.

Baltimore & Ohio.

In the United States District Court at Columbus, O., Aug. 28, Judge Bingham declined to grant the injunction asked by the Western Union Telegraph Company restraining the Baltimore & Ohio Railroad Company from transferring its telegraph wires between Columbus and Wheeling from the Western Union Company's poles to the Atlantic & Pacific Telegraph Company's poles, and from receiving commercial messages at stations where none but railroad telegraph operators are employed, by which means the profits of such messages are enjoyed by the Atlantic & Pacific Telegraph Company instead of the Western Union Telegraph Company, as heretofore.

The injunction was asked for on the ground of an agreement made between the Central Ohio Railroad and Western Union Telegraph companies several years ago, before the lease of the Central Ohio by the Baltimore & Ohio.

Toledo, Wabash & Western.

The annual rumor that this company intended soon to cease running its cars into Quincy is revived at about the usual season. It is now said that the trains will be withdrawn unless the Quincy people will aid in the building of an independent line for the road from Camp Point to Quincy, where its trains now use the Chicago, Burlington & Quincy track. It does not appear likely that Receiver Cox would take such action just now, or that anything would be done until the questions relating to the foreclosure sale are settled.

Dividends.

Dividends have been declared by the following companies:

Terre Haute & Indianapolis, 5 per cent., semi-annual, payable Sept. 15.

Lehigh Coal & Navigation, 1½ per cent., quarterly, payable Sept. 2.

New York Central & Hudson River.

The tramp nuisance along this road has become so great that Superintendent Priest of the Eastern Division has been obliged to take action to suppress it. He has established special police patrols all along his line with orders to arrest all tramps or vagrants. By New York law it is trespass to walk upon a railroad track, and tramps found doing so will be prosecuted accordingly.

Omaha & Republican Valley.

A company by this name has been organized in Nebraska to build a railroad from the Union Pacific near Waterloo Valley, Neb., southward through Saunders, Butler and Polk Counties. The projectors expect to receive aid from the Union Pacific.

Louisville, Paducah & Southwestern.

This road was sold under a decree of foreclosure of mortgage granted by the United States Circuit Court at Louisville, Ky., Aug. 24. The Main Line, from Elizabethtown, Ky., to Paducah, 185 miles, was bought by H. W. Smithers and A. Marcus, trustees, for account of the bondholders, the price paid being $700,000. The Louisville Extension, from Cecilian Junction to Louisville, 46 miles, was bought by M. K. Jesup, George Webb and John T. Moore for account of the Extension bondholders, for $540,000. The terms of sale were cash on confirmation of the sale.

It is understood that the bondholders are acting in concert and that the Main Line and Extension will not be separated, but will remain as one road in the reorganization.

Davenport & Northwestern.

At an election held in Davenport, Ia., Aug. 26, it was voted by a large majority to levy the proposed nine mill tax in aid of the extension of this road from East Davenport into the city. The tax will produce about $40,000, and the cost of the extension is estimated at $200,000.

Raleigh & Augusta Air Line.

A cargo of iron for the extension of this road southwest to the Carolina Central crossing at Hamlet, N. C., has been received, and tracklaying has been resumed. The work, which has been delayed by waiting for this iron, will be pushed forward as fast as possible.

Lehigh & Eastern.

The contractors, Williams & Woods, broke ground for this road at Matamoros, Pa., opposite Port Jervis, this week. Only a small force of men is employed at present, which is to be gradually increased.

The bridge over the Delaware between Matamoros and Port Jervis which the Pennsylvania State authorities have called upon the Erie Company to rebuild, as required by its Pennsylvania charter, is upon the location adopted for the crossing of this road. It is now said that some arrangement for the building of the bridge will be agreed upon by the two companies.

Cincinnati, Hamilton & Dayton.

It is said that an agreement has been concluded between this company and the Cleveland, Columbus, Cincinnati & Indianapolis for the pooling of all their business between Dayton and Cincinnati and the division of earnings on a basis not made public. The management of the pooled business is to be in charge of Mr. L. Williams, General Superintendent of the Cincinnati, Hamilton & Dayton. This arrangement will enable both companies to make a considerable reduction in the expenses of the business by doing away with trains run in competition and in other ways, besides securing better rates for the work done.

Gilbert Elevated.

In the suit brought by the Sixth Avenue Railroad Company to restrain this company from building its road through Sixth avenue in New York, the Superior Court has decided that the clause in the law under which the road is constructed in a manner different from that contemplated in the charter is unconstitutional; that the plaintiff has such rights in the case as to entitle it to bring the suit, and that the injunction must be granted. The case will undoubtedly be carried up to the court of last resort.

Western North Carolina.

Work is progressing steadily on the extension of this road from Old Fort, N. C., to Asheville. The work now in hand is chiefly heavy rock cutting and tunnel work, on which progress is necessarily slow. The contractor on the Swannannoa tunnel has now 1,000 feet through, leaving 800 feet still to be blasted out. The telegraph line is being put up along the whole length of the extension.

Erie.

It is said that orders have been given for prompter payment of the employes of the road hereafter. The paymaster was busy last week paying off for June, leaving about two months in arrears, as August was over before his work could be completed.

The London *Times* of August 24, in its financial article, says: "An amended Erie reconstruction scheme has been issued providing that up to 1879 four coupons of the first consolidated bonds are to be paid in cash, and six funded. All the coupons after 1879 will be paid, and coupon bonds bearing interest at 7 per cent., and payable in gold in 1920, will be issued in exchange for the funded coupons. The second consolidated mortgage bondholders are to fund ten consecutive coupons from June 1, 1875, to Dec. 1, 1879, and the convertible gold bondholders are to fund 18⅔ quarterly coupons within the same dates. Coupon bonds for these funded coupons will bear 5 per cent. interest till 1883, and thereafter 6 per cent. All bonds and coupons must be forthwith deposited with the Reconstruction Committee, who will foreclose on the railway and buy it on behalf of the bondholders. A new company is to be formed to work the line. Half the shares of the new company are to be vested in Trustees, to be called voting Trustees. The shareholders in the present company are to be admitted to the new company on payment of their assessment on the shares."

This is nearly the same scheme proposed at a meeting of Erie investors in Glasgow, Aug. 16, by Sir Edward Watkin and Mr. Hugh J. Jewett. At this meeting, however, it was said that if stockholders would pay an assessment of $3 on preferred and $6 on common shares they would receive income bonds for the amount; but if they preferred they could pay $2 and $4 instead, without any bonds in return, thus valuing the income bonds at 33⅓ per cent of their face.

The Hoosac Tunnel Line.

Manager Prescott reports the operations of the tunnel and State road for the year ending July 30 as follows:

Passenger tolls.....	
Freight tolls.....	$19,025
Rent from Troy & Boston Company.....	44,235
Postal service.....	12,000
Sundry sources.....	3,200
	331
Total.....	$79,371
Expenses (56 per cent.).....	44,706
Net receipts.....	$34,666

There passed through the tunnel 66,130 passengers and 166,245 tons of freight, of which 106,574 tons were in the last half of the year. During the year 113,691 tons were in the last half tons bound to points west of the Hudson River. Of the expenses $39,725 was for salaries and wages.

The arching is now all completed and the only work remaining to be done is a little about the opening of the central shaft. The use of the tunnel has developed no trouble or inconvenience with respect to ventilation.

The present rates of toll are considered to be as low as the State ought to accept. Manager Prescott repeats his former recommendation that the most satisfactory and profitable method of using the State road would be to provide a full equipment of locomotives to move the trains and to take a *pro rata* share of the rates on through and local traffic, instead of allowing trains of other roads to pass over and simply charging toll as at present.

No accident has happened to any employe or passenger on the road or in the tunnel during the year.

Cleveland, Columbus, Cincinnati & Indianapolis.

The freight depot in Cincinnati took fire early on the morning of Aug. 30 and was entirely destroyed, with the freight housed in it. The fire originated among a lot of kerosene oil barrels, but in what way is not known. The depot was of brick, 400 by 80 feet, and was valued at $25,000. There was an unusually large amount of freight in the house, the value of which cannot be accurately known, but it is estimated at from $150,000 to $200,000. Much of this loss, however, will fall on the consignees, as a great deal of the freight had been left in the house over 24 hours, after which time the company ceased to be specially responsible for it.

Cleveland & Mahoning Valley.

In order to pay off the issue of $487,900 third-mortgage bonds, which become due Sept. 16, a new issue of 30-year 7 per cent. bonds is offered in London. Holders of present third-mortgage bonds may, if they desire, exchange them for the new bonds. The balance not so exchanged is offered to holders of Atlantic & Great Western leased line rental bonds at 286 per $500 bond, being about 95. The road is leased to the Atlantic & Great Western, and all its stock is held by the trustees of the leased line rental bonds as security for those bonds.

Fitchburg.

The work of altering the location of the Vermont & Massachusetts Division at South Ashburnham, Mass., has been completed, and the new track will be used for the first time this week. The new track leaves the old about a mile east of South Ashburnham and rejoins it a short distance west of the Chesshire Junction. Hitherto all trains have had to be reversed and the engines turned around at that point, but this trouble-some change is avoided by the new location.

Boston, Clinton, Fitchburg & New Bedford.

The shops at Lowell, Fitchburg and New Bedford are to be given up and the repair work of the consolidated road is to be concentrated at the Taunton shop. The buildings at Taunton will be much enlarged and the tools from the other points taken there. All repair work will be done there and all new freight cars required built.

Central, of New Jersey.

On the night of Aug. 27 one of the large coal shipping piers at Elizabethport, N. J., caught fire and was entirely destroyed, with 75 coal cars which were standing upon it and two canal boats which were lying alongside. Some 400 tons of coal were dumped into the water. The loss is estimated at $40,000.

Colorado Central.

Mr. W. G. Brown, General Passenger Agent, telegraphs to us as follows, under date of Aug. 25: "No changes of officers on our line. The Receiver has not taken charge, notwithstanding the newspapers to the contrary." No later advices have been received.

Hoosac Tunnel Line.

The contract of B. N. Farren for the deep cut at Bardwell's Ferry, on the State road, has been completed, and his connection with the line as a contractor is closed. The contract to rebuild the section of the line through Vermont, about seven miles, has been let to Rice & Munson.

Parker & Karns City.

The grading of the extension from Karns City, Pa., to Butler is completed as far as Millerstown, and tracklaying was begun last week.

Chicago, Rock Island & Pacific.

Tracklaying has been resumed on the extension of the Oskaloosa Branch westward. The men are now employed between Oskaloosa, Ia., and the Keokuk & Des Moines Crossing near Leighton.

Atlantic & Great Western.

The statement that the Pennsylvania Company had begun suit to enjoin the use of the third rail on this road from Sharon Junction, Pa., to Greenville is denied. The mistake made by the local papers appears to have been caused by a confused report of an injunction sued out to prevent the Sharpsville & Oakland road from crossing the Erie & Pittsburgh tracks at grade, which was granted on application of the Pennsylvania Company as lessee of the last named road.

Whitby & Port Perry.

A contract has been let for the extension of this road from Port Perry, Ont., north by east to Lindsay, about 22 miles. Work is to be begun this fall and completed by Aug. 1, 1877.

Gulf, Western Texas & Pacific.

In response to an inquiry whether the running of trains on this road would soon be resumed, Mr. M. D. Monserrate, Treasurer, writes to the Lavaca (Tex.) *Herald* as follows: "I regret to have to inform you that the prospect of resumption of business by this road at an early day is very poor indeed. Dependent as we are almost entirely on the local trade, the earnings are not sufficient to cover its expenditures."

Hamilton & Northwestern.

The Toronto (Ont.) *Monetary Times* says: "The City Council of Hamilton has refused to allow the Hamilton & Northwestern Railway Company to set aside the terms of the original contract, which specifies the construction of the road on the bay side of the beach. Should the directors depart from the contract, or fail to carry out their obligations, the Council has

decided to withhold the money voted to the line. The company can scarcely afford to part with such assistance, and it is likely it will find it necessary to fulfill its pledges."

Gilman, Clinton & Springfield.

Reports are current that the bondholders, who now own the road, have made arrangements to lease it to the Illinois Central, and that the transfer will be made in September. The road is now being put in good order, and the work is nearly completed. The Illinois Central can use it to better advantage than any other company, probably. It has heretofore run cars through between Chicago and Springfield in connection with it.

Cairo & St. Louis.

The operations of this road for July are reported as follows:

Gross earnings ($154 per mile)	$22,594 69
Working expenses (79.45 per cent.)	17,952 31
Extraordinary expenses (14.18 per cent.)	3,204 76
Total expenses (93.63 per cent.)	$21,157 07
Net earnings ($9 per mile)	$1,437 62

The mileage worked is 146¼ miles. Coal trains ran 8,607 miles; freight trains, 9,759 miles; passenger trains, 10,426 miles; total train mileage, 28,792 miles. The average receipts per train mile were, for passenger trains, 64.51 cents; for freight trains, 81.41 cents; for coal trains, 92.05 cents.

Wisconsin Central.

The track is now laid and trains are running to Phillips, Wis., seven miles north of the late terminus at Worcester, 108 miles north of Stevens Point and 273 from Milwaukee. The tracklayers are working north of Phillips and have nearly reached Elk Lake.

Sioux City & Pembina.

The grading on this road is completed to Calliope, 40 miles north of the present terminus at Portlandville, Ia. Tracklaying will follow soon, and it is expected that trains will run to Calliope this fall.

Cornwall Canal Improvement.

The lowest bid for this Canadian work, at Cornwall, on the St. Lawrence River, is said to have been that of Gordon & Co., of Sherbrooke, P. Q., which was a little over $400,000. They will receive the contract if their securities are satisfactory.

Gainesville, Ocala & Charlotte Harbor.

A company by this name has been organized in Florida to build a railroad from a point on the Georgia line in Columbia County southward through Lake City and Ocala to Charlotte Harbor, on the Gulf of Mexico, a distance of about 260 miles. There is also to be a branch about 25 miles long to Tampa Bay. The incorporators are J. B. Brown, N. R. Gruelle, H. C. Howard, James Hunter, Thomas C. Lanier, B. F. Matthias, George H. Packwood and G. B. Phinney.

Manchester & Keene.

Work on the Keene end of the line has been temporarily suspended, owing to the difficulties of Mr. E. L. Barrett, who holds the contract for 12 miles of grading. A number of suits have been brought against him and his property attached.

Potomac, Fredericksburg & Piedmont.

The new owner of this road, the Royal Land Company, is now engaged in changing the track already laid to 3 ft. gauge. Some 18 miles was completed from Fredericksburg, Va., westward in 1873.

The surveys of the new line west have been nearly completed to Harrisonburg. The section from Orange Court House to Rawley Springs is to be let very soon.

Green Bay & Minnesota.

The contractors, C. C. Smith & Co., are pushing the work on the line from Onalaska, Wis., to La Crosse, and it will soon be ready for the rails.

A survey has been made for the proposed branch from Plover, Wis., to Stevens Point. Nothing further will be done, however, unless some local aid is given.

Clinton Bridge.

This company, which purposes building a pontoon bridge over the Mississippi at Clinton, Ia., has made a contract with that city, by which the city is to pay $7,500 annually for the use of the bridge as a wagon bridge. In return the City Council is to have power to collect tolls and regulate the use of the bridge.

Nashville, Chattanooga & St. Louis.

The operations for July, the first month of the fiscal year, are reported as follows:

	1876.	1875.	Inc. or Dec.	P.c.
Gross earnings	$127,395 63	$116,054 43	Inc.. $11,341 20	9.8
Expenses	82,883 38	71,233 31	Inc.. 11,650 07	16.4
Net earnings	$44,512 25	$44,821 12	Dec.. $308 87	0.7
Cost of iron bridge on Harpeth River to replace Howe truss burned	4,763 70			
Taxes accrued for m'th	1,703 75			
Int. accrued for month	36,510 00			
Total charges	$42,977 45			
Net balance	$1,534 80			

The expenses were 65.06 per cent. of earnings in 1876, and 61.38 per cent. in 1875.

East Line & Red River.

The first locomotive for this road has been received, and the work of laying track will now be prosecuted steadily. The town of Dangerfield, in Titus County, Tex., has raised $13,000 as an inducement for the location of the road through the town, and other local subscriptions are being received.

Sarnia, Chatham & Erie.

Arrangements are being made to begin work on this road at several points. It is to extend from Sarnia, Ont., southward through Chatham to Blenheim on Lake Erie, about 55 miles.

The Illinois Tax Cases.

A Springfield (Ill.) dispatch says:

"Attorney-General Edsall has entered a motion in the United States Court to dissolve the injunction heretofore granted against the collection of taxes on the capital stock of the Indianapolis & St. Louis Railroad Company. The injunction was granted on the ground that the company was a corporation of the State of Indiana, but it is now alleged as the basis of this motion that the lease by which the company controls and operates the St. Louis, Alton & Terre Haute line was approved by the general assembly of this State, thus making the company a corporation of Illinois. The argument on this motion is to be heard on Sept. 6."

Brunswick & Albany.

Reports are current that negotiations are in progress for the sale or lease of this road to some English parties who are largely interested in lands along the line.

Cumberland & Piedmont.

A dispatch from Cumberland, Md., dated Aug. 23, says: "Judge Pearre filed to-day his opinion in the case of the State of Maryland vs. the Consolidation Coal Company, overruling the demurrers of the State to the defendant's pleadings, giving judgment on the demurrers for the defendant, and dismissing the petition of the State. It is understood that Attorney General Gwinn will carry the case to the Court of Appeals for final adjudication. The object of the suit was to enforce the provisions of the two acts of the last General Assembly reducing the tolls on the road of the Consolidation Company."

The road referred to is the Cumberland & Piedmont, formerly the Cumberland & Pennsylvania.

Kansas & Nebraska.

A director of this company informs us that it is not fair to include the $2,250,000 land scrip in the capital account of this road, as it is based solely on the land grant and is under the control of two trustees appointed for the purpose. It has nothing to do with the road itself. If we deduct this land scrip, the total amount of securities to be issued by the company will be $4,800,000, or $41,739 per mile, which is still an amount very much greater than the road can possibly earn interest upon for some time to come.

Fond du Lac, Amboy & Peoria.

A correspondent writes us as follows: "Work on this road has been temporarily suspended on account of the failure of payment of the contractors, Lehman & McHugh. They are having some trouble among themselves."

Burlington, Keosauqua & Western.

At a meeting held recently at Burlington, Ia., resolutions were passed in favor of aid to this projected road. Application is to be made for the holding of an election in accordance with the present State law on the question of levying a 2 per cent. tax in aid of the road.

New York & Oswego Midland.

The Receivers, A. S. Hewitt and J. G. Stevens, make the following statement for the three months ending June 30:

Balance on hand April 1	$10,069
Receipts from all sources	142,755
Total	$152,824
Disbursements for the quarter	147,352
Balance, July 1	$5,472

The disbursements were $4,597 in excess of the receipts.

A survey has recently been made of the line of the Western Extension from Scipio Centre, N. Y., to Auburn. It is reported that it has been done by the Utica, Ithaca & Elmira Company.

Texas Land Grants.

The Texas General Land Office makes the following statement of land certificates issued to the railroads of the State:

	Acres.
Buffalo Bayou, Brazos & Colorado	896,640
San Antonio & Mexican Gulf	238,720
Galveston, Harrisburg & San Antonio	867,200
Total included in Galveston, Harrisburg & San Antonio	2,002,560
Houston & Texas Central	4,769,280
Washington County	243,120
Waco & Northwestern	481,280
Total included in Houston & Texas Central	5,493,680
Memphis, El Paso & Pacific	321,280
Southern Pacific	368,640
Texas & Pacific	1,763,840
Total included in Texas & Pacific	2,453,760
Houston & Great Northern	2,311,040
International	2,573,800
Total included in International & Great Northern	4,884,840
Indianola	179,840
Gulf, Western Texas & Pacific	302,720
Total included in Gulf, Western Texas & Pacific	482,560
Houston Tap & Brazoria	512,000
Texas & New Orleans	1,228,800
East Texas	287,720
Galveston, Houston & Henderson	611,840
Rusk	79,360
Columbus Tap	49,280

Making a total of 18,086,400 acres for which certificates have been issued.

Atlantic & Pacific.

Hassler's *Financial Report* says: "The plan of reorganization submitted to the bondholders is substantially as follows:

"The new company to be called the St. Louis & San Francisco Railway Company—because, perhaps, it has no terminus in either city.

"The present outstanding issue of $7,200,000 South Pacific land grant construction bonds to remain intact.

"Then an issue of $5,700,000 new bonds, to be made as follows:

"Series A, $500,000, bearing 6 per cent. interest, payable May and November of each year.

"Series B, $2,800,000, bearing interest at 2 per cent. for two years; 3 for three years; 4 for one year; 5 for one year, and 6 from and after Nov. 1, 1883.

"Series C, $2,400,000, bearing interest the same as those of Series B.

"Then is to be issued a new first preferred stock to the amount of, say, $4,500,000.

"Then a common preferred stock of $10,000,000; and a common stock of $9,500,000. * * *

"As to the disposition of these securities it is proposed:

"Bonds of Series A shall be purchased at par by those who unite in the reorganization.

"Bonds of Series B shall be given bond for bond of the principal of the present outstanding land grant bonds.

"Bonds of Series C shall be exchanged in a similar manner for the outstanding second mortgage bonds.

"For all unpaid and past-due coupons of the land grant, second, and income bonds, for all surrendered interest on the proposed new issues of bonds, and also for the blue bonds and blue bond scrip, with past due interest—for all these the first preferred stock shall be given.

"The $10,000,000 common preferred to be given in exchange for the same amount of present Atlantic & Pacific preferred.

"The $9,500,000, similarly, for present Atlantic & Pacific common.

"Such is the proposed disposition of the bonds and stock; but the present owners are not to be permitted to join in the reorganization unless they will purchase bonds of Series A as follows:

"Owners of land-grant bonds and second-mortgage bonds shall buy new bonds to the amount of 1½ per cent. of their old bonds.

"Owners of the $2,200,000 unsecured 6 per cent. bonds to buy to the amount of 5 per cent. of their old bonds.

"Owners of present preferred and common stock to pay, respectively, 1 per cent. and 0¾ per cent. on their holdings.

"It is proposed that this arrangement shall cover the portion of the line lying in Missouri; but at the same time it is intimated that the Central Division, as it is called, which lies in the Indian Territory, can be used by the new company by paying on its bonds, $1,190,000, the same rate of interest as is proposed for Series B of the new bonds."

The interest on the old South Pacific land-grant bonds amount to $432,000 gold yearly; the new issue of $500,000 will add $30,000 interest, and the $5,200,000 issued for the land grants and seconds will bring an interest charge of $104,000 the first year, rising to $312,000 in 1888. Thus the total interest charge under this scheme will be $566,000 for two years, $618,000 for the next three years, $670,000 for the sixth year, $722,000 for the seventh, and $776,000 thereafter—always with the addition of the premium of the $432,000 gold interest. This amount must be earned by about 300 miles of railroad.

Chicago, Dubuque & Minnesota.

It is said that at a conference between representatives of the bondholders and stockholders of this company and the Chicago, Clinton & Dubuque, the stockholders agreed to surrender all claims to the property on condition of receiving $100,000 in new bonds, to be distributed among them *pro rata*. Arrangements for the reorganization of both companies will now be completed at once.

Pittsburgh, Wheeling & Kentucky.

A movement is on foot for the consolidation of this road with the projected Pittsburgh & Lake Erie. If carried out it will involve a considerable change in the route of the last-named road.

Pennsylvania Transportation Company.

Pittsburgh papers state that this company has given orders for the manufacture of the 286 miles of 4-inch lap-welded pipe needed to construct its projected oil-pipe lines to the seaboard. The pipe is to stand a test of 1,500 pounds to the square inch. Over 8,000 tons will be required, costing about $750,000. The contracts are to be filled by Dec. 1, and are divided among six firms. The company has also ordered five batteries of boilers in Pittsburgh.

Chicago, Clinton & Western.

It is said that the people of the towns along the line have agreed to take a sufficient amount of the Receiver's certificates to secure the completion of the road to Iowa City.

Iowa Land Grants.

The Secretary of the Interior has reversed a previous decision of the General Land Office, and now decides:

1. The State of Iowa by its own act is estopped from claiming lands certified to railroad companies under the act of 1856 as swamp lands under the act of 1850.

2. When lands have been once regularly certified under a railroad or other grant by the Interior Department, they will not be again certified, except in extreme cases, where, without such certification, the party entitled to the land would be remediless.

3. The act of Congress approved Jan. 31, 1873, in relation to public lands, and on which the decision of the General Land Office was based, does not apply to lands already certified.

The decision affects a considerable quantity of land held by different companies, which the State claimed on the ground that it was included in the general grant of swamp and overflowed lands made to the several States in 1850.

Central Pacific.

The work of laying rails on the Ione Branch has been begun, and a large part of the iron is on the ground. Work is to be continued steadily until the branch is finished. The new branch leaves the Main Line at Galt, Cal., and runs to Ione City, 28 miles. It is intended to serve some coal mines at Ione, and passes through a very good country.

The grading on the loop line from Oakland to Banta is progressing rapidly. The engineers are now setting the grade stakes through the San Pueblo Rancho and towards Pinole.

North Tule.

A railroad 4½ miles long has been built and is in operation on the North Tule River at Dillon's Mills, 25 miles above Porterville, Cal. It is laid with yellow pine rails, 5 in. square, capped with iron plates 2 in. wide. The loaded cars are run down to the mills by gravity and the empty ones drawn up by mule power. There is one grade of 1,000 ft. to the mile.

San Luis Obispo & Santa Maria Valley.

This road is now completed from the town of San Luis Obispo, Cal., to its shipping port at Avila, a distance of about nine miles. It is of 3 ft. gauge. It is proposed to extend it beyond San Luis Obispo into the Santa Maria Valley, some 16 miles.

North Pacific Coast.

The tunnel at Dutch Bill Canon, on the extension from Tomales, Cal., to the Russian River, is completed. It is 390 ft. long, 13½ ft. wide and 14¾ ft. high in the clear. The terminus of the road on Russian River will be at the mouth of Dutch Bill Canon, where a site has been selected for a town, which will be called Moscow. Only four miles of grading remain to be finished. Tracklaying is in progress from Tomales and trains will soon be able to run as far as Freestone. It is expected that they will run through to Moscow about Nov. 1.

Illinois Central.

A general reduction of wages has been ordered on a sliding scale, as follows: On all salaries between $60 and $75 per month, 5 per cent.; between $76 and 100, 10 per cent.; between $101 and $200, 12 per cent.; between $201 and $300, 15 per cent.; between $301 and $500, 20 per cent.; over $500 per month, 25 per cent. This applies to all officers and employes receiving stated monthly salaries. The reasons given are the light business and low rates prevailing, and a return to former rates as soon as possible is promised.

Chicago, Danville & Vincennes.

The Court has ordered the Receiver to pay a number of small claims for wages and supplies accruing within six months prior to the appointment of a receiver. The entire amount of the claims is $20,060.29.

Rockford, Rock Island & St. Louis.

The deed and conveyance of this road to Heyman Osterberg under the foreclosure sale was finally executed in the United States Circuit Court in Chicago, Aug. 25.

Columbia & Port Deposit.

The track is now laid to Phyte's Eddy on the Susquehanna, 23 miles southeast from Columbia, Pa., and 13 miles beyond Safe Harbor, where tracklaying was stopped last spring. Work is also in progress on the Port Deposit end of the line. The track is being ballasted and surfaced as fast as laid.

Harlem Extension.

The Rutland (Vt.) *Herald*, of Aug. 18 says: "An interesting decision has recently been rendered by Judge Wheeler, in Bennington County on the subject of town bonds given in aid of the construction of a railroad.

"In 1867, when the Troy & Boston Railroad Company broke off connection with the Bennington & Rutland Railroad, the inhabitants of that portion of the State were left without any outlet by rail beyond Bennington. At the solicitation of the people of the various towns on the line of the Bennington & Rutland road, an extra session of the Legislature was called by Gov. Dillingham, at which an act was passed authorizing certain towns to issue their bonds in aid of the construction of the Lebanon Springs Railroad, to connect with the Bennington & Rutland road at Bennington and with the Goshen railroad at Chatham, New York. Under the authority of the act all of these towns subscribed for stock and bonds in the Lebanon Springs road and issued their own bonds in payment of the subscription. For some years after that road was completed and in operation the interest on the bonds was regularly paid. But for several years past payment of the interest has been refused, and a bill in

chancery was filed by the town of Bennington against Mr. Trenor W. Park, who held a considerable amount of the bonds, praying for an injunction against his disposing of or suing upon them, and that they might be declared invalid. The grounds of the bill were the unconstitutionality of the acts under which the bonds were given, alleged irregularity in the proceedings, and various general charges of fraud upon the Governor, the Legislature, and in obtaining the assent and votes of the several towns. A temporary injunction having been obtained, a motion by Mr. Park to dissolve it was argued at the last June term at Manchester before Chancellor Wheeler, by E. J. Phelps, for Mr. Park, and Messrs. Gardner, Sibley and Davenport for the town of Bennington.

"Judge Wheeler's opinion has been recently given, dissolving the injunction, and deciding the questions in regard to the validity of the bonds."

The Lebanon Springs and the Bennington & Rutland roads were subsequently consolidated as the Harlem Extension. The decision is substantially that the bonds were legally issued and have been, since their issue, so recognized by the town as to ratify and approve them most effectually. At any rate there is no such presumption of illegality or fraud as to justify the continuing of the injunction.

Northern, of Canada.

At the semi-annual meeting of stockholders in Toronto, Ont., Aug. 16, the President reported that the earnings and expenses for the half-year ending June 30 were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Gross earnings	$388,679 90	$354,994 12	Inc.. $33,685 78	9.1
Expenses	232,349 82	234,372 25	Dec.. 1,922 43	0.8
Net earnings	$156,330 08	$120,721 87	Inc.. $35,608 21	29.5
Per cent. of expenses	59.77	65.99	Dec.. 6.22	9.4

Adding the balance from 1875, the amount carried to net revenue account for the half-year was $157,430.38.

The interest upon all the companies' debentures has been punctually paid. The sum of $21,973.64 was expended on new construction, and a balance of $12,109.67 left at the close of the half-year. The road and buildings are in good condition. The Gravenhurst Division has been completed by the construction of 14 miles of new track. The wharves and buildings at the Muskoka terminus have also been completed and brought into use. The Lake Superior traffic, however, has fallen off considerably this year, owing to the competition of other lines.

Owing to the difficulty of negotiating the sale of the new preference stock authorized at the last meeting, the £100,000 due the Dominion of Canada has not been paid, but an extension of time to Nov. 1 has been secured. The President refers to the appointment of a commission to investigate the affairs of the company, and, while doubtful of the power of the Government in the case, recommends that every facility for investigation be given.

The report was received, and after a little discussion the meeting approved its recommendations.

Baltimore, Chesapeake & Delaware Bay.

It is said that arrangements are being made to secure the construction of this road from Queenstown, Md., eastward to Harrington, Del., 35 miles. Near Harrington connection will be made with the Junction & Breakwater road, and it is believed that there will be a considerable traffic between Baltimore and the lower Peninsula by this route, a steam ferry being established across Chesapeake Bay between Queenstown and Baltimore.

Junction & Breakwater.

It is reported that this company has offered to build an extension of six miles from Lewes, Del., eastward to Rehoboth Beach, a well-known summer resort and camp-meeting ground, provided parties interested in the Rehoboth Beach Association will take $20,000 stock.

Delaware, Lackawanna & Western.

It is stated that this company is making arrangements to concentrate all the repair work of the Main Line and Bloomsburg Division at the Scranton shops. The subordinate shops at Kingston, Great Bend and other points are to be closed, and the tools and material taken to Scranton. Only the necessary round-house repairs will be done away from the main shops. It is said that the same policy will be adopted on all the leased divisions, the work in each being concentrated at one point, and minor shops discontinued. It is believed that the work can be done more economically and more efficiently, and can be kept under closer supervision by thus concentrating it.

Laurens.

A public meeting was held in Laurensville, S. C., Aug. 7, to make arrangements for securing the rebuilding of the remaining nine miles of this road, from Clinton, S. C., to Laurensville. It was stated that of the $30,000 promised from the town $23,000 had been raised, and that the company purposed extending the track to Milam's Trestle, five miles beyond Clinton, without requiring any further payment. Committees were appointed to raise the $7,000 needed by collecting the old subscriptions or securing new ones.

Jonesboro.

The Jonesboro Railroad Company has been organized in Arkansas for the purpose of building a railroad from Jonesboro, in Craighead County, Ark., west by north to the St. Louis, Iron Mountain & Southern at Walnut Ridge. The road is to be of 3 ft. gauge and about 20 miles long.

THE SCRAP HEAP.

Darien Ship Canal.

Mr. John C. Trautwine, C. E., who was Chief Engineer of the Panama Railroad in 1850, and made explorations and surveys for a canal in 1852, writes to *The Polytecnic Review*, estimating the cost of a ship canal at $300,000,000, and repeats the conviction expressed in his report in 1852, "that no ship canal between the two oceans would be found *practicable in a practical sense*, that is, that would pay a sufficient interest on its cost to recompense any company that should undertake its construction." He also predicts that the new survey authorized by the Columbian Government by way of the rivers Atrato and Tuyra will result in disappointment.

He Paid His Fare.

"Is your name Carmon?" asked an Illinois Central conductor the other day.

"Why," stammered the man, "isn't the pass genuine?"

"That's not the question, sir! Is your name Carmon?" demanded the conductor in savage tones.

"Why,—um—ah—no! My name is Mr. ——, I am a man of influence in our church of Merrowy, and brother Carmon let me have this pass to use. He said it would be all right."

"Well, sir," said the conductor, "it is not all right. That is a deliberate game to swindle our company. My instructions are to take up this pass and collect fare. I suppose a man of your great influence and reputation as a Christian will have money enough to pay his fare like an honest man."

He had the money, and he paid his fare; but brother Carmon lost his pass and is not likely to get another soon, as the railroad company doesn't like the way Merrowy church members have of doing business.—*Decatur Times.*

The Brutal Conductor.

The other morning as the conductor of a train going west from Detroit was passing around after tickets, he came to a man who waved him away with a very important air, at the same time remarking, "Pass on, sir; pass on." "I want your ticket," replied the conductor. "Ticket, you hireling of anarchy," shouted the man, puffing out his cheeks. "Sir, I own this road! I bought it just before leaving Detroit, and while I would like to retain you in my employ, you must be more civil or I shall discharge you on the spot, even if you have a dozen children to support." "I must have your ticket or the money," said the official. "Consider yourself discharged!" roared the man. He was left on the track between two stations. He sat down on a log to pin his paper collar on, and his last words as the train moved off were: "Gentlemen, this outrage will make this country shudder from Maine to Texas."—*Detroit Free Press.*

A Belgian Steam Car.

The *Moniteur des Interets Materiels* describes a vehicle, tried last July between Brussells and Denderleeuw, invented by a Mr. Belpaire, an inspector general of Belgian State railroads, and designed especially for suburban traffic. The car is divided into three distinct compartments, one containing the motive power and carrying an engineman and fireman; the second, separated from the first by a platform, is for second-class passengers, having seats for 22 on four longitudinal benches; the third is for 22 first-class passengers, also on four rows of seats; behind is a second platform like the first one. There are doors between the different compartments.

The motive power consists of a Field boiler, designed for a pressure of 150 lbs., with a vertical engine with two cylinders which work directly upon the middle of the forward axle. There are two Gifford injections and a meter tank, placed under the car, with capacity for 250 gallons. There is no condenser: the steam escapes by a chimney passing through a roof which covers the whole vehicle. There are no connecting rods. The weight of the vehicle gives sufficient to the front wheels, which serve as drivers. It is said to be able to go up grades of 77 to 105 ft. per mile. Provision is made for attaching a light car, with which one conductor and the two men on the engine give sufficient force. This car is to run regularly between Ghent and Biston in Belgium.

The leading dimensions are:

Boiler.—Exterior diameter, 43¼ in.; height to spring of smoke stack, 8 ft. 3¾ in.; grate surface, 3½ square feet; heating surface, 267 square feet; water space, 195 gallons; steam space, 135 gallons; steam pressure, 150 lbs.; horse-power, 25.

Cylinders.—6½ in. diameter and 12 in. stroke.

Car.—Interior width, 9 ft. 10 in.; length from buffer to buffer, 35 ft. 6 in.; wheel-base, 16 ft. 5 in.; diameter of wheels, 3 ft. 2¼ in.; speed per hour, 18¼ miles; weight empty, 16,602 lbs. on forward axle, 5,016 lbs. on middle axle and 5,214 lbs. on rear axle, or 22,192 lbs in all. It is estimated that when fully loaded, with the little baggage which passengers might take with them, the vehicle would weigh 35,200 lbs., 16,000 lbs. of which would be on the forward axle and available for adhesion.

Rail Consumption in France.

According to the *Annales Industrielles*, the consumption of iron and steel rails in France in 1874 and 1875 was, in tons of 2,204 lbs.:

	1875.	1874.	Inc. or Dec.	P.c.
Steel	120,661	102,228	Inc.. 18,433	18.0
Iron	96,889	125,667	Dec.. 28,778	22.9
Total	217,550	227,895	Dec.. 10,345	4 5

The great increase in the consumption of steel coincident with a decrease in the total consumption is noticeable. The consumption of rails in the United States for the same two years, as reported by the Iron and Steel Association was about 337,695 tons (of 2,000 lbs.) in 1874 and 810,770 in 1875, equivalent to 758,925 and 729,700 of the French ton. The American consumption thus appears to have been 3½ times that of France both years.

ANNUAL REPORTS.

Nashville, Chattanooga & St. Louis.

This company owns and works the following lines:

	Miles.
Chattanooga Division, Chattanoogo, Tenn., to Nashville	157
St. Louis Division. Nashville, Tenn., to Hickman, Ky	170
Jasper Branch, Bridgeport, Ala., to Jasper, Tenn	12
Shelbyville Branch, Wartrace, Tenn., to Shelbyville	8
Total	341

The Chattanooga and St. Louis divisions together form a line 321 miles long, from Chattanooga to the Mississippi River at Hickman. The St. Louis Division was formerly the Nashville & Northwestern road, and was bought from the State of Tennessee by the company (then the Nashville & Chattanooga) and completed to Hickman. The "St. Louis" was added to the name after this purchase.

The present report covers the year ending June 30, 1876.

The equipment consists of 83 engines; 26 passenger and 11 baggage cars; 700 box, 49 stock and 200 flat cars; 1 pay an 2 wreck cars.

The capital account at the close of the year was follows:

Capital stock ($20,085 per mile)	$6,848,899 95
Less amount held by the company	273,604 32
Amount outstanding	$1,575,295 63
Bonds outstanding ($19,974 per mile)	6,812,000 00
Profit and loss	69,147 87
Bills payable, balances due, interest accrued	550,506 82
Interest accrued during the war, fundable in Tennessee State bonds	148,220 00
Total ($41,511 per mile)	$14,155,170 32

The company has assets unavailable amounting to $294,012.51, consisting of stocks and bonds, claims, supplies on hand, etc., and available assets amounting to $473,862.18, consisting of stocks and bonds, real estate not used for road or depot purposes, bills receivable, balances due and cash. The outstanding bonds consist of $4,700,000 7 per cent. 40 year bonds; $1,100,000 6 per cent. bonds endorsed by the State of Tennessee. $1,000,000 4 per cent. bonds held by the United States, and $12,000 unendorsed Nashville & Chattanooga bonds. To meet the endorsed bonds and those held by the United States $2,100,000 consolidated bonds are held in reserve. The cost of road and equipment is reported at $13,387,295.63 or $39,259 per mile.

The General Superintendent's report gives the following statements of traffic and averages:

Passenger train mileage	460,175
Freight " "	796,269
Engine mileage	1,389,728
Car "	12,637,078
Average earnings per passenger train mile	$1.13
" " " freight " "	1.51
" " " mile, all trains	1.394
" expense " " "	0.79
" net earn. " " "	0.604
" cost of locomotive service per mile run	0.217
Number of passengers carried	183,997
" tons freight "	650,500

Of the tonnage moved 520,996 tons were on the Chattanooga and 129,504 tons upon the St. Louis Division. On the Chattanooga Division the chief items of freight were 39,118 bales cotton, 252,361 barrels and 2,127 tons (in sacks) of flour, 29,105 tons bacon, 3,246,422 bushels grain, 31 332 tons pig iron, 7,659,847 feet lumber and 215,594 tons (of 25 bushels) coal. On the St. Louis Division the chief items were 7,527 bales cotton, 6,276 hogsheads tobacco, 171,035 barrels flour, 1,408,844 bushels grain, 5,506 tons bacon, and 3,456,453 feet lumber.

There was an encouraging increase in north-bound tonnage, giving loads for cars usually running empty. Full crops along the line increased the local, but slightly decreased through tonnage. Fifteen freight engines, not required for present business, are stored up. It is recommended that all freight engines not able to haul 16 cars over the Chattanooga Division be sold or exchanged.

During the year 626 head of stock were killed on the road and claims to the amount of $16,404.86 were presented, which were compromised by the payment of $8,913.68.

The Resident Engineer reports four new spans of wooden bridge, three turn-tables and 924 feet trestle rebuilt; extensive repairs on bridges and trestles; an engine shed built at Nashville, 33 by 255 feet, and several minor buildings renewed. A steam excavator has been bought and the work of filling in trestles begun. Two spans (100 feet each) of Fink combination truss were built by the Louisville Bridge Company to replace a wooden bridge burned. Steel rails have been adopted entirely for renewals on the Chattanooga Division; 12½ miles were laid during the year and 25 miles more contracted for, for use during the current year. There were laid also 18 miles of new iron rails.

The earnings of the year were as follows:

	1875–'76.	1874–'75.	Inc. or Dec.	P. c.
Freight	$1,207,167 59	$1,128,171 21	Inc.. $78,996 38	7.0
Passage	480,889 51	488,782 43	Dec.. 7,892 92	1.6
Mail	38,608 92	38,608 92	....	....
Rents and privileges	24,933 85	25,263 63	Dec.. 329 78	1.3
Total earn..	$1,751,599 87	$1,680,826 19	Inc.. $70,773 68	4.2
Working exps	996,269 61	1,151,954 45	Dec.. 155,684 84	13.5
Net earnings	$755,330 26	$528,871 74	Inc.. $226,458 52	42.8
Gross earn. per mile	5,136 65	4,929 11	Inc.. 207 54	4.2
Net earn. per mile	2,215 04	1,550 94	Inc.. 664 10	42.8
Per cent. of expenses	56.88	68.53	Dec.. 11.65	17.0

Another statement of the sources of income is as follows:

Local freight proper	$558,829 18
Local passage proper	238,964 08
Shipments from Nashville	114,552 43
Shipments from Chattanooga and points South to Nashville	40,015 19
Through freight proper	415,980 97
Through passage proper	241,9 5 43
Transfer at Nashville	3,830 52
Memphis & Charleston freight between Stevenson and Chattanooga	64,929 05
Through cotton from Stevenson	2,567 25
Alabama & Chattanooga toll freight between Waahatchie and Chattanooga	6,463 00
Mails, rents and privileges	63,542 77
Total	$1,751,599 87

Of the through freight proper $208,391.06 was from business over the Louisville & Nashville, of which $89,941.58 was from and to Cincinnati and points north of the Ohio; $19,493.91 was from St. Louis & Southeastern connection at Nashville, and $118,449.50 was on business to and from connections of the St. Louis Division.

The net results of the year were as follows:

Net earnings		$755,330 26
Interest on bonded debt	$438,120 00	
Interest on floating debt and exchange	18,163 77	
Taxes in Tennessee	23,442 78	
Taxes in Alabama	3,711 15	
Two dividends, 1½ per cent. each	194,573 59	
		678,011 29
Surplus for the year		$77,318 97

The directors' report says: "This exhibit is highly satisfactory and encouraging to the directors, and they trust it may be so to the stockholders. These results have been accomplished by material reduction in the salaries of all officers, clerks and agents, and close attention to details, and seeing that all material and supplies were furnished at the lowest market price for cash; and, requiring that the laborer should be worthy of his hire, *awarding him that promptly and cheerfully to the day*, without any drones in office or elsewhere; and at the close of the fiscal year find your road in better condition that at any time heretofore, as reported by the Resident Engineer.

"Expectations indulged in in last report have been more than realized. The usual semi-annual dividends of 1½ per cent. on the capital stock were paid to the stockholders for the fiscal year, on the first days of October and April. About $95,000 of the floating debt was paid off during the fiscal year, besides paying interest on the bonded debt and dividends to the stockholders. The directors expect to be able to pay off the small balance of floating debt without interfering with dividends; and, with this end in view, a resolution was passed by your directors, last September, ordering that at least 10 per cent. of the net earnings, each month, should be applied to reducing the floating debt before any dividends were paid to the stockholders. Last year more than this amount was appropriated for that purpose, without interfering with the regular semi-annual dividends, as the foregoing statements show. * *

"The local freight business of your line increased last year, over the preceding year, $164,636.69, which is a very encouraging feature; and there are interests on the line of your roads being enlarged, and new ones being built up, which promise to add largely to the local business. Prominent among these improvements may be mentioned the enlargement of the coal mines on the Cumberland Mountain, owned by the Tennessee Coal & Railroad Company, by which the facilities for delivering coal to your road, at Cowan, will be greatly increased. * * *

"On the — day of March, 1876, your directors made a contract with the Southern States Coal, Iron & Land Company (of England), limited, by which it is expected the coal and iron interest will be developed in Sequatchie Valley, and iron and steel works established at Battle Creek (South Pittsburgh), on the line of the Jasper Branch. The company referred to are now industriously at work, laying the foundation for works at Battle Creek, and opening coal mines in Sequatchie Valley. Your company undertake to extend the Jasper Branch up the Sequatchie Valley for a distance not exceeding 14 miles. At present only 7¾ miles will be built, to their first colliery; which our Engineer estimates will not cost exceeding $90,000, the money to pay for which, the English company is to furnish, and take thirty-year coupon 8 per cent. currency bonds at par, with mortgage *on the extension only*. In addition to this, they guarantee to spend $2,000 on their works at Battle Creek for every $1,000 spent on the extension, besides opening out at least one colliery in Sequatchie Valley, and to extend *at least* $300,000 in erecting blast furnaces and works at Battle Creek, within five years, and pay contract rates for transportation on main line and branches, which shows the earnestness with which they go into the undertaking.

"The company has large means, and it is expected that they will build up a large business. No better location for business upon a large scale could have been selected, as there is both coal and iron ore in the Sequatchie Valley, in close proximity to each other, which greatly facilitates and cheapens the manufacture of iron and steel.

"Besides the business developed by this and other companies that may establish themselves in this valley, filled with iron ore and coal, there is a considerable agricultural interest in the valley, which (the lands being rich), will be developed by the extension; all of which will add business to the main line."